THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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J. A. BERLY'S).

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A CONFERENCE AND A CONVENTION.

WHILE London is in the midst of its Coronation festivities, and weekly publications and business people continue to suffer pretentiously unperturbed from the general disorganisation of traffic and of life, two gatherings of an important character are being prepared for—one in London, of an entirely serious character from beginning to end, the other at Brighton, with many serious matters to discuss, but with a measure of the lighter side of life to relieve the over-taxed mind of the Convention-goer.

The first of these is the conference of the Institution of Civil Engineers on engineering education and training, at which on June 28th and 29th, a number of very important subjects already announced, will be handled by authorities. As we have always, in these pages, taken a very active part in the discussion of all that appertains to raising the standard of training, and modernising the education, of entrants to the engineering profession, we wish the Conference complete success, and trust that its outcome will be some real progress towards the furtherance of the most enlightened ideas, and the adoption of methods and systems most calculated to assure the maintenance of the leadership of British engineers and British engineering among all the nations of the world.

The second gathering to which we allude is, of course, the annual Convention of the Incorporated Municipal Electrical Association, which meets at Brighton on June 27th and several following days. Those who remember the starting of this organisation in 1896 will, no doubt, regard Brighton as a centre of particular interest to the Association, for was it not there, now 15 years ago, in this merry month of June, that the first annual meeting terminated, the idea of the formation of the Association having been advanced by Mr. J. H. Rider in the previous year at a meeting held in London to discuss the Board of Trade Rules? Many are the changes that have come over the *personnel* of municipal electrical engineering in the intervening period. Mr. Arthur Wright, then Brighton's "chief," was the first president, and Messrs. W. Arnot and C. H. Wordingham were vice-presidents, while Mr. W. L. Madgen was honorary secretary. All of these, and many more who had an early interest in the Association, have said a fond and affectionate farewell to municipal electrical life, and exercise their abilities in maybe more congenial spheres. It is edifying at this juncture to glance back at the address of the first president, and see how leading city electrical engineers of the day, such as Mr. Arthur Wright, were urging for attention some of the very problems that we continue to discuss to-day. In his recital of the manifold questions confronting such officials, he alluded to the financial and commercial aspects of electricity supply. We remarked at the time in our pages: "There is a wonderful lack of uniformity in most matters relating to municipal electrical works, and Mr. Wright unhesitatingly

places his finger on the weak spots." "There is not only the question of what to do with the profits, there is considerable difference of opinion as to what constitutes profit. Some build up large reserve funds, and consider the surplus profit, while others . . . . . hold that repayment of loan is equivalent to reserve." Wiring questions, the remuneration of the engineer, methods of charging—all of these pressed for solution then, and so they do in somewhat altered conditions, to day. We dwelt upon the importance of the engineer adopting the business attitude, for the commercial development of electricity supply was then only in the newness of the bud. Mr. Wright pointed out to engineers of that day the danger that confronted many of them, when he quoted the opinion of sound business men who believed that "electricity undertakings would progress much faster if their managers took as much interest in understanding the commercial problems as they did in the over-absorbing engineering details and the fascinating scientific points connected with the industry." Much electricity has issued from Brighton stations since those words were spoken, and the altering conditions year by year have themselves forced engineers in most places to attend to the commercial side of their undertakings, but we are not sure whether there are not a number of them who still need that 15-year old danger impressed upon them.

Fifteen years ago the desirability of some co-operation existing between company and municipal managements for electricity supply development was urged in these columns, but though the Association has not opened its membership doors to company men as such, it does not deny them the privileges of hospitality and fraternising for which an annual convention provides opportunity. The wide publicity movement, started in the metropolitan area, is a step in the right direction, in so far as it includes both the municipal and company concerns in its deliberations. We are confident that electricity only stands to gain, and so do electricity departments and officials, by an increasing co-operative spirit, whatever the ownership of their undertakings.

While in the list of subjects announced for the Brighton Convention financial and commercial problems do not appear to figure very prominently, we have no doubt that these aspects of municipal electricity supply will continually be presenting themselves in the course of unofficial conversations between members present, especially in view of the interest which has been aroused for some time past in council chambers as to the proper disposal of surpluses on electricity supply. Some uniformity of procedure, with a certain measure of elasticity to render it adaptable to particular cases would, we should say, be very welcome.

The Petrol-Electric 'Bus.

Elsewhere in this issue we refer at some length to two recent developments in petrol-electric road traction. To one of these, Messrs. Tilling's second venture in that direction, particular interest attaches, as the vehicle which we illustrate may almost be regarded as a reply to the much-talked-of "B" type 'bus to which the London General Omnibus Co. is generally assumed to have pinned its faith.

While we do not pretend to know the running costs of these recent purely petrol-driven 'buses, presumably they are no secret in the 'bus world, and it is only reasonable to suppose that Messrs. Tilling's second edition would not have made its appearance unless there was substantial reason for expecting even more favourable results than can be obtained with the gear-driven vehicle.

We recollect some two-and-a-half years ago, when Messrs. Tilling's first petrol-electric 'bus had run over 30,000 miles and shown a saving (in repairs, maintenance, oil, &c., though not in petrol) of 1½d. per mile over the firm's gear-driven vehicles, that excessive weight and first cost were urged against it. The weight of the new 'bus has been brought down to about 3½ tons, a saving of over a ton as compared with the earlier one, and as to the extra first cost—what does it amount to? If the experience of the earlier vehicle is repeated—and with its reduced weight and smaller engine, a considerable improvement is confidently expected—the saving in running costs over a few thousand miles ought to justify the extra first cost, were there no other consideration of importance, as there actually is.

For one cannot ignore the fact that the travelling public, especially in London, has been led to expect the maximum of comfort as well as the minimum of cost in its journeyings, as witness the modern corridor railway coaches, and the latest additions to tramway rolling stock which are replacing the less costly and less perfect vehicles of a year or two ago.

Rightly or wrongly, we believe that, once the chaotic conditions of the omnibus world have been reduced to something like order, the demand for some measure of comfort in 'bus travel on the part of the passenger, and for more effectively controlled and less noisy vehicles on the part of the police and general public, will be met, at least in part, by the adoption of an electrically controlled 'bus, which, even though it costs a little more at first, perfectly achieves the objects in view.

Factories and Workshops.

The report of the Chief Inspector for 1910 contains much interesting matter. We are reproducing elsewhere the bulk of the report by Mr. G. Scott Ram, Electrical Inspector to the Home Office, from which it will be seen that while there has been a decrease in the number of accidents in electricity works, there has been a slight increase in factories; but the increase is by no means in the same proportion as the increase in the use of electrical energy, so that in point of fact there has really been relatively a decrease all round, a result for which a proportion of credit is certainly due to the new Regulations. Unfortunately, it appears that owners are apt to take no steps to comply with the Regulations until the inspectors make them do so, and even in work carried out recently the responsible engineers in some cases have ignored the Regulations—an attitude which is not creditable to them, and which we hope will not in future be observed. The cutting of prices and false economy have also led to the installation of dangerous and unsatisfactory work.

In other departments, it is interesting to note that in its final report, the Departmental Committee on Humidity and Ventilation in Cotton Weaving Sheds frankly recommends the abandonment of tests for CO_2 at times when gas or oil has to be used for lighting the sheds, or even until the dinner-hour on the day following such use, although the means of ventilation required to maintain the daylight standard are kept in full operation. This obviously means that that standard cannot be maintained when gas or oil is used. Yet we are often told that *gas improves ventilation!*

The use of gas irons has been shown to result in the liberation of carbon monoxide, which was found present (in the case of suction gas) in so large a proportion as 6·6 to 8·6 parts per 10,000 in the air near the appliances. No wonder the employés suffered from headache and faintness. As for the flueless gas stove, a case is recorded where 39·5 parts of CO_2 per 10,000 were found to be present. In another case, 37·1 parts were found.

It is pleasing to note that electric irons have in several cases been substituted for "gas irons emitting noxious fumes." A lady inspector says that where gas irons are used the "air invariably shows much sign of free gas"; and "one or two defective irons can make things very unpleasant for a roomful of people."

CENTRAL STATION COSTS.

BY "INTERESTED."

THE importance of keeping accurate cost records cannot be urged with too much emphasis. In municipal stations this subject is engaging a large amount of attention at the present time, and it is sure to command serious thought within the next few years. Those old 42-year loans are like unto thorns in the side of some undertakings just now. However, that is a side issue in this article. My intention here is to deal more particularly with "running costs." I take it for granted that every works has in use some kind of system for recording particulars of expenditure, both on account of capital and revenue. About the systems themselves, more anon. The following remarks are generally applied to the form taken when presenting the final figures. Coming to the point at once, I suggest that costs should be kept in such a manner as to allow the chief engineer or manager an opportunity of looking over the figures week by week. He would then have a chance, before it is too late, of checking extravagance in any department, and would likewise retain a continual hold of all expenditure. At the end of a month or quarter, one can only talk about heavy items in the accounts, but when a weekly return is prepared, waste and extravagance can be nipped in the bud, as the saying goes, and prevented from recurring. One form suitable for presenting these weekly totals is illustrated herewith.

For the sake of convenience the diagrams are arranged in three sections. The whole could very well be included in a book having the complete pattern running right across an opening. A book thus made up would prove a large one, but the advantage gained thereby is that any heading can be seen at a glance without turning over pages, and also two of the total columns shown could then be dispensed with. Another method is to have these three patterns printed under each other on a page, so that in place of a long narrow book "column in line abreast" fashion, this would form one of more standard dimensions. Cards are out of the question here, as, unless they were bound in a big loose-leaf cover—which method can hardly be commended, for they would be unwieldy in practical use—they would require a large cabinet for very few cards.

At the end of the week, or directly a week's costs are finished, details are transferred from the numerous cost cards, assuming such are used, or from sheets and books, or from whatever form the costs are recorded in, to the proper headings in this weekly book. Let us take the columns right across. First we get a narrow column for an index to the weeks: 1st, 2nd, 3rd, and so on. Next comes the date of each week end. Then spaces are introduced for units "calculated," "metered," and "to mains." The weekly log-book or sheet supplies these figures. Now we get to Coal. There is not a great deal to explain here, the quantity used and the cost of the same being obtained from the cost-cards or sheets, &c., mentioned above. Following, spaces are provided for the coal cost per unit "metered" and "to mains." These are for the sake of comparison week by week, the figures being worked out to three places of decimals. These are of vital importance to the chief, as coal is one of the largest items of expenditure. Imagine, for instance, that at one week end the figures are up about ·05d. per unit as compared with the previous week. The chief immediately wants to know the reason, and questions form themselves naturally: "Anything wrong?" "Bad coal?" "Bad stoking?" or "What is the matter?" Inquiries are instituted in the proper quarters, and someone is called to give an explanation of the apparent excess.

The next few headings call for little comment, save Coaling and Coal Carting. The word coaling is here intended to mean the cost of coal trimming, and Coal Carting is the cost of unloading and carting fuel from the wharf or railway siding to the works, providing that work is carried out direct by the department; otherwise, where fuel is delivered right into the works at an inclusive figure, the price of the same would be shown under the heading of Coal.

Establishment Charges refer to those recurring items

—	Week ending.	Units.			Generation.										Repairs and maintenance.		Total station costs.	—
					Coals.		Coal cost per unit.		Wages.				Coal carting.	Material.				
		Calculated.	Metered.	To mains.	Weight.	Cost.	Metered.	To mains.	Driving, firing, cleaning, &c.	Engineers.	Coaling.		Rags, waste, &c.	Oil.	Wages.	Material.		
1 2 &c.																		1 2 &c.
Totals																		
Corresponding quarter of last year																		

Week No.	Total station costs.	Revenue establishment charges.	Management (office, &c.).		Distribution.						Total cost. Wages and material.	Total cost per unit.		Last year's total costs per unit.		Week No.
					Mains.		Sub-stations.		Meters.							
			Wages.	Mat'rl.	Wages.	Mat'rl.	Wages.	Mat'rl.	Wages.	Mat'rl.		Metered.	Mains.	Metered.	Mains.	
1 2 &c.																1 2 &c.
Totals																
Last year's totals																

Week No.	Total cost. Wages and material.	Public lighting.		Trading account.		Special charges.				Revenue total.	Capital.				Week No.
						Station.		Mains.			Station.		Mains.		
		Wages.	Material.	Wages.	Material.	Wages.	Material.	Wages.	Material.		Wages.	Material.	Wages.	Material.	
1 2 &c.															1 2 &c.
Totals.															
Last year's totals.															

D

which, for various reasons, cannot be properly allocated to any particular heading, and the total of this column is divided in proper proportion over the whole of the other revenue amounts at the end of each three months in the quarterly analysis book, which is described later.

Office is for general office charges: wages, printing, stationery, advertising, &c.

Distribution is explained fully enough by the headings themselves, the work being divided into three lots: Mains, Sub-stations and Meters.

By Total Cost is meant the sum of running costs plus distribution. Here, again, the total cost per unit "metered" and "to mains" is shown, solely as a guide to any appreciable increase week by week. The costs for the previous year are also shown here, and afford a means of comparison by which an idea is obtained as to the efficient working of the undertaking. Any excess of much account over the weekly returns of last year can be inquired into, and the head of the particular department concerned called in to explain the reason for the increase.

Summary for quarter ending..... 19 .....

CAPITAL.

Section.	Sub-section.	Labour.	Materials.	Petty cash.	Sundries.	Sub-section. Total.	Section. Total.	Remarks.
Buildings	Generat'g station							
	Sub-stations							
	Furniture							
Machinery	Boilers							
	Engines							
	Auxil'y appar'tus							
	Steam piping							
Accumulators	Accumulators							
Mains	Mains							
	Services							
Transformers	Transformers							
Motors, &c.	Motors							
	Sub-stations							
	Switchboards							
Meters	Meters							
Electric instruments	Instruments							
Tools	Tools							
Stores and miscellaneous	Stores, &c.							

REVENUE.

Section.	Sub-section.	Labour.	Materials.	Petty cash.	Sundries.	Sub-section. Total.	Section. Total.
Generation	Coal						
	Wages, oil, &c.						
Repairs and maintenance	Engines						
	Boilers						
	Auxiliary plant						
	Buildings						
Distribution	Distribution						
	Trading						
Public lighting	Public lighting						
Management	Offices						

Following on across the pattern we come to Trading Account and Public Lighting. These two are thrown out separately from each other and apart from what might be termed running charges, because in each case payment should be received sufficient at least to cover the expenditure. Strictly speaking, Public Lighting is a Trading Account, but it is shown by itself because it is one of those items so frequently under discussion, and the cost is often requested at short notice.

Special Items is intended for work of a capital nature which is paid for from revenue account. Small replacements, additions, &c., for which loans will not be taken up come under this heading.

Revenue Total gives inclusively all revenue costs, including trading accounts.

In the illustration, Capital is divided into two parts only: Station and Mains, but as many others can be added as may be deemed necessary, and a total column might also be included.

Quarterly Summary Book shows an analysis of the figures at the end of each quarter, particulars being abstracted from the cost cards or sheets, and the totals balanced with those in the weekly cost book. Such items as Rates and Taxes, Insurance, &c., are here added, being allocated to the proper headings. This book follows on the lines of accounts arranged by the Board of Trade. Some of the headings might very well be dispensed with, and others altered slightly in wording, but that is just a matter of choice for anyone requiring such a book.

If the arrangement suggested here is followed, and a weekly return of all costs submitted to the chief, it will enable a strict hold to be kept over all expenditure. The mere fact of being able to compare costs week by week with those for the corresponding dates in the previous year is a help towards the efficient working of a station, and will afford an inducement to try for better results year by year.

PROCEEDINGS OF INSTITUTIONS.

Automatic Telephone Exchange Systems.

By W. AITKEN, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, May 18th*, 1911.)

IN this country the development in the past has been almost entirely with manually operated switchboards. This type of switchboard has progressed from magneto drop indicator and call-wire working, through various stages with mechanically and electrically restored indicators and branching jacks instead of series jacks, to the full common-battery switchboard with parallel wiring and relays controlling lamp signals.

From time to time automatic features have been introduced to simplify the operating, and thereby expedite the speed of connection. These automatic features have been principally introduced on the incoming junction switchboards which control the work between different exchanges in the same area, and where it is essential that the operating be of the very best. The insertion of the connecting plug into the jack of the line wanted, in addition to making the connection between the two lines, automatically cuts off the operator's testing circuit, introduces the supervisory signals, and in many cases connects up the ringing circuits so that the subscriber is automatically intermittently rung until he answers.

Keyless ringing incoming junction circuits have been designed both to expedite operating and to facilitate maintenance. They allow of the number of incoming junction lines per operator being increased from 27 to 36, with actually less fatigue to the operator, and, by substituting a double make and break relay for the electromagnetic ringing key, the wiring of the circuits is greatly simplified and the cost per circuit reduced.

As in the ordinary key-ringing incoming junction circuits, these circuits may be arranged for either order wire or call by ringing working.

The British Insulated & Helsby Cables, Ltd., have lately introduced small switchboards of my design, in which the connections are controlled by a rotary multi-contact electromagnetic switch, so that when a connection is made manually, it is held electrically and automatically disconnected, and all apparatus is restored to the normal condition when the subscriber replaces the telephone receiver after a conversation. At present, on small switchboards, clearing signals are given to the attendant when the telephone is replaced; but with these new switchboards the lines are automatically disconnected, and all apparatus restored to the normal condition by the replacing of the telephone. This will make the work from the private branch exchange to the central exchange much more positive, and prevent delays occurring at the central exchange due to slow operating at the private branch exchange. These boards are, primarily, designed for small exchanges where there is no regular attendant, say, up to 20 or 30 lines.

With the present class of boards it will be at once realised that slow operating will prejudicially affect the operating in the central exchange. For example, if a connection has been made, at the private branch exchange board, between the exchange line and an extension line, and the telephone at the extension instrument is replaced after a conversation, the clearing signal will show immediately at the central exchange and at the private branch exchange. As there is no regular operator, however, at the latter, the line having been cleared at the central, another operator may connect and fail to get the private branch exchange switchboard, but would call the extension instrument, and so a delay in operating would be caused. Again, if the extension line, after clearing to the central exchange, desire a second connection to another line on the private branch exchange board, a false call will be sent in to the central exchange, again interfering with the efficiency of the operating there. Such troubles cannot arise with a board giving automatic disconnection, as a second call in either direction would cause the line indicator to respond.

Practically, there is only one full-automatic exchange system in common everyday use—that of the Automatic Electric Co., of Chicago. It is claimed by this company that there are 300,000 telephones working on their system, San Francisco, Oaklands, Los Angeles, Columbus, Grand Rapids, and Chicago being among their largest installations. San Francisco and Los Angeles are both laid

out on a basis of 100,000 lines. The former has already four exchanges, with three at Oaklands, across the bay, most of them of 10,000-line capacity. Los Angeles has six main and four branch exchanges equipped for 25,700 lines. These exchanges are on the common-battery system. The Chicago system is just being brought into use, and is said to be suitable for 1,000,000 lines.

The greater number of exchanges are on what is known as the three-wire system, the signalling being over the two wires alternately with earth return, but in San Francisco, and other later exchanges, all signalling is effected by the intermittent opening of the circuit at the subscriber's instrument. This has greatly simplified the subscriber's instrument.

All the facilities given on a manual exchange are now repeated on the automatic, and in some instances with a greater degree of flexibility. Junction working is practically eliminated. The ringing of the called subscriber is automatic. Calls are metered or registered (the system, however, gives free or unregistered calls when talking to officials, &c.). Party lines are efficiently dealt with, and also private branch exchanges.

FIG. 1.—TABLE PATTERN INSTRUMENT.

The subscriber's instrument may be of any of the well-known patterns, fitted with a dial switch. The switch has finger-holes near the circumference, into one of which a finger is placed, and the dial revolved until the finger comes against a stop.

Fig. 1 shows an instrument with the small circular switch for opening the line only. Under each of the finger-holes is placed a figure, 1 to 9, then 0, and any number is made up by inserting the finger successively over the figures that go to make up the number wanted and pulling the dial round. If 637 be wanted, the finger is placed over 6, and the dial revolved to the stop, then 3 and 7 are similarly dealt with. In the three-wire system this dial, as it revolves, intermittently earths one or other of the wires, and thus

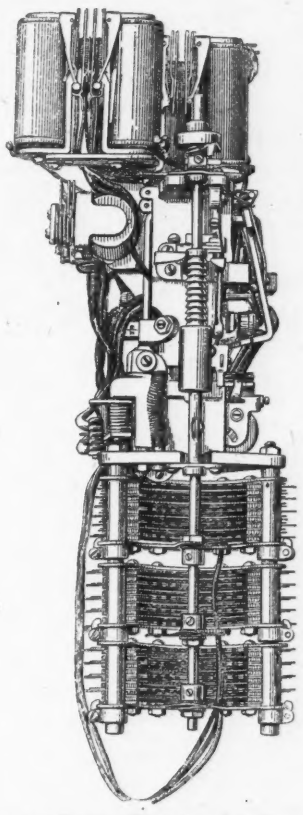


FIG. 2.—COMMON-BATTERY CONNECTOR.

completing a circuit from a central battery causes step by step electromagnetic mechanism to perform certain functions. In the later system these functions are now performed by the dial simply intermittently opening the circuit which has been completed by lifting the receiver.

Fig. 2 shows a general view of a "connector" (the essential piece of mechanism of an automatic exchange), and fig. 3 the diagram of connections. A small exchange might be composed only of connectors, one being provided for each line. On a frame of non-magnetic material a vertical shaft is mounted, free to lift upward and revolve. The upper part of the shaft has teeth cut round it, and below

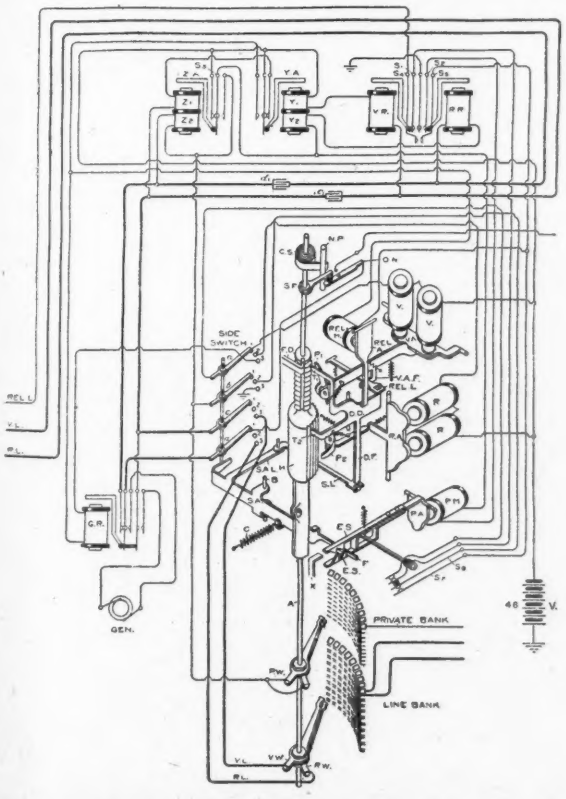


FIG. 3.—C.-B. CONNECTOR AND CIRCUITS.

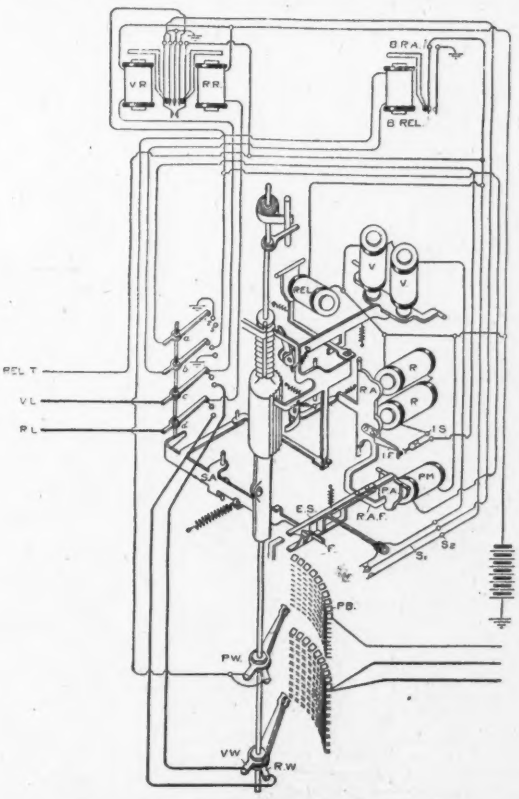


FIG. 4.—DIAGRAM OF SELECTOR CONNECTIONS.

this are other teeth in the line of shaft, 10 teeth in each case. The shaft is raised and rotated by electromagnets. One, called the vertical magnet, acts on the teeth surrounding the shaft, and lifts the shaft to a height corresponding to the number of impulses sent, and the number of impulses depends on the second last figure of the number required—*e.g.*, if the number were 67, then the shaft would be raised to the height of six teeth. Another magnet would then be switched into action, and it would act on the teeth in the line of the shaft and rotate it, the distance depending again on the number of impulses sent; in the case of the number 67, the shaft would be rotated a distance of seven teeth. The shaft at the bottom has attached to it, and insulated from it, and from each other, contact springs or wipers, which, brush fashion, wipe over contacts associated with the lines to be called. These banks of contacts are arranged in an arc of a circle, and each line bank has 10 pairs of springs in the height, usually in two groups, and 10 contacts horizontally in the arc, wiped over by two twin contact arms. In these contacts are terminated 100 lines. A second bank is placed above this having 10 contacts in the height and 10 in the arc. These are connected to the test, or line-engaging circuits, which are purely local and correspond to the wires connecting the jack bushes together in a manual exchange. As the shaft rises vertically step by step, the wipers come to rest in line with the contact levels, so that when the shaft is then rotated the wipers brush over the intervening contacts in the arc, until the wipers come to rest on the contacts of the line required. When the receiver is replaced after a conversation, both lines are earthed simultaneously, or, the circuit is opened, allowing a release magnet to operate on the "dogs" (which maintained the shaft in the position brought about by the electromagnets already described), when the shaft is rotated in the reverse direction by a coiled spring until it is free to fall by gravity to the normal position.

On reference to fig. 3, it will be noticed that these magnets are in local circuits and are controlled principally by two relays across the line circuit, and through the windings of these two relays the current for the microphone of the calling subscriber is fed in the well-known manner. (The current for the called subscriber's microphone is fed through another pair of coils on the opposite side of condensers.) One line relay is known as the vertical relay, and the other as the rotary; actually the former relay controls both the vertical and rotary movements, the latter relay being the circuit changing or switching relay. An important adjunct of the connector is the side switch which is controlled by the private magnet. This is a four-lever three-position switch.

Reverting again to the dial on the instrument, it should be mentioned that after every series of impulses corresponding to the figure of the number sent over the vertical relay wire, one impulse is sent over the opposite wire which actuates the circuit-changing relay which controls the private magnet, so that this extra impulse causes the side switch to step one position after each figure, first to change from the vertical to the rotary electromagnet, and, secondly, to join the lines through. When the two lines are connected the circuit is a clean straight one, all switching apparatus being cut out of the circuit.

Should the line be already engaged this will be indicated by a vibrating tone in the calling receiver. This is brought about as follows:—When the shaft is rotated the upper wiper puts earth on the local test circuit. Should another line now call for the same number the private wiper will make contact with that multipled tag while the side switch is in the second position, and this earth will complete a circuit through the release magnet, and release the shaft so that it returns to the normal position. When the subscriber rings the shaft will be again lifted and this allows two springs to make contact which connect with the ringing current through a special interrupter which gives the engaged signal.

For an exchange from 100 to 1,000 lines a "selector" is fitted in addition to the connector. Fig. 4 shows the connections of a selector. This is very similar to the connector, but rather simpler as there are fewer relays, and after it has performed its work it joins the lines through and leaves no electromagnets attached. In its operation it differs from the connector in that after the shaft has been raised due to impulses from the dial it rotates automatically until a junction line is found to a disengaged connector. This is brought about as follows:—After the dial earths over the vertical line have raised the shaft, and the earth on the rotary line has actuated the private magnet P M which has moved the side switch to the second position, a local circuit is completed from earth through lever *a* of side switch through contact I S, through electromagnet R to battery and earth. The shaft is rotated one step and the armature P A is depressed by the extension R A F. If that line to a connector is idle (*i.e.*, insulated), the P M will move the side switch to the third position, when the line will be joined through. Should, however, the first connector line be engaged, the armature P A will be held down, as a circuit is completed from earth on private bank (due to engaging selector) through P W coil of B relay, side switch lever *b* in second position and P M coil to battery and earth.

The electromagnet R I attracting its armature R A by finger I F, opens the circuit at springs I S, so that the armature is released. The armature is reattracted, and this movement continues, rotating the shaft until the wipers engage with an idle line, when the private magnet armature P A is released and moves the side switch to the third position, when the lines are joined through. The selector is then entirely cut off from the lines, these being joined straight through.

A Keith "line switch," fig. 5 (fig. 6 shows the circuits), is now introduced between the subscriber's line and a selector. This is a most ingenious device to avoid the necessity for having an expensive selector associated with each line. Each circuit has its line and cut-off relay, like the manual exchange, and a release relay. These are arranged on each side of a vertical moving shaft in groups of 25; 12 on one side and 13 on the other. This shaft is pivoted and has a backward and forward movement. Each relay has a pivoted arm, or plunger, whose fan-shaped end has a notch which engages with the moving shaft normally. As the shaft moves it carries with it the plungers and causes them to move on their pivots, so that the

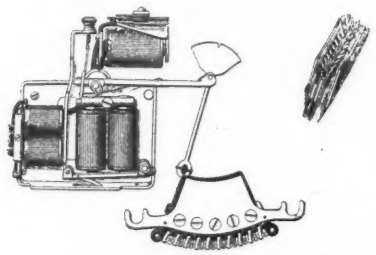


FIG. 5.—KEITH LINE SWITCH (THREE-WIRE).

point, which carries an ebonite roller, is moving in front of sets of springs. One bank or level of 10 groups of springs is in line with each plunger. The corresponding groups of springs in a unit are multipled together and connected to a selector. The unit is usually made up of four sections of 25, with which 10 selectors are associated, and the shaft is rocked by a master electromagnet. When the telephone is removed, and before the dial is touched, the line switch is operated automatically. The line or tripping relay has disengaged the plunger arm, and a spring drives the plunger into a group of springs, and also disengages it from the shaft, so that the subscriber's line has been extended to a selector; at the same time local circuits have been completed through the cut-off relay and the master switch electromagnet, so that the shaft is

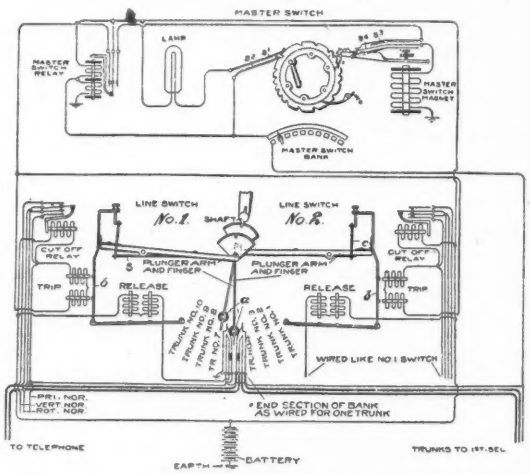


FIG. 6.—TWO ADJACENT LINE SWITCHES, AND DIAGRAM OF MASTER SWITCH.

moved one step and the remaining 99 line relay plungers are opposite the No. 2 selector group of springs. The next call will engage No. 2, and the remaining 98 will then be carried opposite No. 3, the selector being thus always pre-selected. As the plungers become free the shaft picks them up on its return journey.

In the two-wire system the mechanism is very similar to that of the three-wire, but the electromagnets or relays controlling these are different. Advantage is taken of the slow-acting characteristic of relays having a mass of copper attached, so that two relays in series are actuated by the first completion of the circuit, but only one responds to the dial impulses.

The three relays of the line switch are now combined in a most ingenious manner into one having three armatures.

(To be concluded.)

Wireless Telegraphy.

By G. MARCONI, D.Sc., M.I.E.E.

(*Abstract of lecture delivered at the* ROYAL INSTITUTION, *June 2nd*, 1911.)

(Concluded from page 953.)

A CURIOUS result which I first noticed over nine years ago in long-distance tests carried out on the ss. *Philadelphia*, and which still remains an important feature in long-distance space telegraphy, is the detrimental effect produced by daylight on the propagation of electric waves over great distances.

The generally accepted hypothesis of the cause of this absorption of electric waves in sunlight is founded on the belief that the absorption is due to the ionisation of the gaseous molecules of the air affected by the ultra-violet light, and as the ultra-violet rays which emanate from the sun are largely absorbed in the upper atmosphere of the earth, it is probable that that portion of the earth's atmosphere which is facing the sun will contain more ions or electrons than that which is in darkness, and, therefore, as Sir J. J. Thomson has shown, this illuminated or ionised air will absorb some of the energy of the electric waves.

The wave length of the oscillations employed has much to do with this interesting phenomenon, long waves being subject to the effect of daylight to a very much lesser degree than are short waves.

Although certain physicists thought some years ago that the daylight effect should be more marked on long waves than on short, the reverse has been my experience; indeed in some trans-Atlantic experiments in which waves about 8,000 metres long were used, the energy received by day at the distant receiving station was usually greater than that obtained at night.

Recent observation, however, reveals the interesting fact that the effects vary greatly with the direction in which transmission is taking place; the results obtained when transmitting in a northerly and southerly direction are often altogether different from those observed in the easterly and westerly one.

Research in regard to the changes in the strength of the received radiations which are employed for telegraphy across the Atlantic, has been recently greatly facilitated by the use of sensitive galvanometers by means of which the strength of the received signals can be measured with a fair degree of accuracy.

In regard to moderate power stations such as are employed on ships and which in compliance with the International Convention use wave lengths of 300 and 600 metres, the distance over which communication can be effected during daytime is generally about the same whatever the bearing of the ships to each other or to the land stations—whilst at night interesting and apparently curious results are obtained. Ships, over 1,000 miles away, off the South of Spain or round the coast of Italy can almost always communicate during the hours of darkness with the Post Office stations situated on the coasts of England and Ireland, whilst the same ships, when at a similar distance on the Atlantic to the westward of these islands and on the usual track between England and America, can hardly ever communicate with these shore stations unless by means of specially powerful instruments.

It is also to be noticed that in order to reach ships in the Mediterranean the electric waves have to pass over a large portion of Europe and, in many cases, over the Alps. Such long stretches of land, especially when including very high mountains, constitute, as is well known, an insurmountable barrier to the propagation of short waves during day time. Although no such obstacles lie

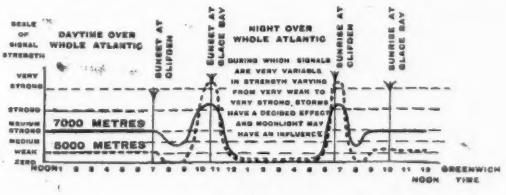


FIG. 6.

between the English and Irish stations and ships in the North Atlantic *en route* for North America, a night transmission of 1,000 miles is there of exceptionally rare occurrence. The same effects generally are noticeable when ships are communicating with stations situated on the Atlantic coast of America.

Although high-power stations are now used for communicating across the Atlantic Ocean and messages can be sent by day as well as by night, there still exist periods of fairly regular daily occurrence during which the strength of the received signals is at a minimum. Thus, in the morning and the evening when, in consequence of the difference in longitude, daylight or darkness extends only part of the way across the ocean, the received signals are at their weakest. It would almost appear as if electric waves in passing from dark space to illuminated space and *vice versa*, were reflected and refracted in such manner as to be diverted from the normal path. Later results, however, seem to indicate that it is unlikely that this difficulty would be experienced in telegraphing over equal distances north and south on about the same meridian, as, in this case, the passage from daylight to darkness would occur more rapidly over the whole distance between the two stations.

Some diagrams have been carefully prepared by Mr. H. J. Round, which show the average daily variation of the signals received at Clifden from Glace Bay.

The curves, fig. 6, show the usual variation in the strength of these trans-Atlantic signals on two wave lengths—one of 7,000 metres and the other of 5,000 metres.

The strength of the received waves remains, as a rule, steady during daytime. Shortly after sunset at Clifden they become gradually weaker, and about two hours later they are at their weakest. They then begin to strengthen again, and reach a very high maximum at about the time of sunset at Glace Bay. They then gradually return to about normal strength, but through the night they are very variable. Shortly before sunrise at Clifden the signals commence to strengthen steadily, and reach another high maximum shortly after sunrise at Clifden. The received energy then steadily decreases again until it reaches a very marked minimum a short time before sunrise at Glace Bay. After that the signals gradually come back to normal day strength.

It can be noticed that, although the shorter wave gives on the average weaker signals, its maximum and minimum variations of strength very sensibly exceed that of the longer wave.

I carried out a series of tests over longer distances than had ever been previously attempted in September and October of last year between the stations at Clifden and Glace Bay, and a receiving station placed on the Italian ss. *Principessa Mafalda*, in the course of a voyage from Italy to the Argentine.

During these tests the receiving wire was supported by means of a kite, as was done in my early trans-Atlantic tests of 1901, the height of the kite varying from about 1,000 to 3,000 ft. Signals and messages were obtained without difficulty by day as well as by night up to a distance of 4,000 statute miles from Clifden.

Beyond that distance reception could only be carried out during night time. At Buenos Ayres, over 6,000 miles from Clifden, the night signals from both Clifden and Glace Bay were generally good, but their strength suffered some variations.

It is rather remarkable that the radiations from Clifden should have been detected at Buenos Ayres so clearly at night time and not at all during the day, whilst in Canada the signals coming from Clifden (2,400 miles distant) are no stronger during the night than they are by day.

Further tests have been carried out recently for the Italian Government between a station situated at Massaua, in East Africa, and Coltano, in Italy. Considerable interest attached to these experiments in view of the fact that the line connecting the two stations passes over exceedingly dry country and across vast stretches of desert, including parts of Abyssinia, the Soudan and the Libyan desert. The distance between the two stations is about 2,600 miles.

The wave length of the sending station in Africa was too small to allow of transmission being effected during the day time, but the results obtained during the hours of darkness were exceedingly good, the received signals being quite steady and readable.

The improvements introduced at Clifden and Glace Bay have had the result of greatly minimising the interference to which wireless transmission over long distances was particularly exposed in the early days. The signals arriving at Clifden from Canada are, as a rule, easily read through any ordinary electrical atmospheric disturbance. This strengthening of the received signals has moreover made possible the use of recording instruments which not only give a fixed record of the received messages, but are also capable of being operated at a much higher rate of speed than could ever be obtained by means of an operator reading by sound or sight. The record of the signals is obtained by means of photography in the following manner:—A sensitive Einthoven string galvanometer is connected to the magnetic detector or valve receiver, and the deflections of its filament caused by the incoming signals are projected and photographically fixed on a sensitive strip which is moved along at a suitable speed.

The importance or utility of the earth connection has been sometimes questioned, but, in my opinion, no practical system of wireless telegraphy exists where the instruments are not in some manner connected to earth. By connection to earth, I do not necessarily mean an ordinary metallic connection as used for wire telegraphs. The earth wire may have a condenser in series with it, or it may be connected to what is really equivalent—a capacity area placed close to the surface of the ground. It is now perfectly well known that a condenser, if large enough, does not prevent the passage of high-frequency oscillations, and therefore in this case, when a so-called balancing capacity is used, the antenna is for all practical purposes connected to earth.

I am also of opinion that there is absolutely no foundation in the statement which has recently been repeated to the effect that an earth connection is detrimental to good tuning, provided, of course, that the earth is good. Certainly, in consequence of its resistance, what electricians call a bad earth will damp out the oscillations, and in that way make tuning difficult; but no such effect is noticed when employing an efficient earth connection.

Wireless telegraphy is tending to revolutionise our means of communication from place to place on the earth's surface. For example, commercial messages containing a total of 812,200 words were sent and received between Clifden and Glace Bay from May 1st, 1910, to the end of April, 1911; wireless telegraphy has already furnished means of communication between ships and the shore where communication was before practically impossible. The fact that a system of Imperial wireless telegraphy is to be discussed by the Imperial Conference now holding its meetings in London shows the supremely important position which radiotelegraphy over long distances has assumed in the short space of one decade. Its importance from a commercial, naval and military point of view has increased very greatly during the last few years as a consequence of the innumerable stations which have been erected or are now in course of construction on various coasts, in inland regions and on board ships in all parts of the world. Notwithstanding this multiplicity of stations and their almost constant operation, I can say from practical experience that mutual interference between properly equipped and efficiently tuned instruments has so far been almost entirely absent. Some interference does without doubt take place between ships, in consequence of the fact that the two wave lengths adopted in accordance with the rules laid down by the International Convention are not sufficient for the proper handling of the very large amount of messages transmitted from the ever increasing number of ships fitted with wireless telegraphy. A considerable advantage would by obtained by the

utilisation of a third and longer wave to be employed exclusively for communication over long distances.

In regard to the high-power trans-Atlantic stations, the facility with which interference has been prevented has to some extent exceeded my expectations. At a receiving station situated at a distance of only 8 miles from the powerful sender at Clifden, during a recent demonstration arranged for the Admiralty, messages could be received from Glace Bay without any interference from Clifden when the latter station was transmitting at full power on a wave-length differing only 25 per cent. from the wave radiated from Glace Bay. The ratio between the maximum recorded range of Clifden and 8 miles is in the proportion of 750 to 1.

Arrangements are being made permanently to send and receive simultaneously at these stations which, when completed, will constitute in effect the duplexing of radio-telegraphic communication between Ireland and Canada.

The result which I have last referred to also goes to show that it would be practicable to operate at one time on slightly different wave-lengths a great number of long-distance stations situated in England and Ireland without danger of mutual interference.

The extended use of wireless telegraphy is principally dependent on the ease with which a number of stations can be efficiently worked in the vicinity of each other.

Considering that the wave lengths at present in use range from 200 to 23,000 ft., and, moreover, that wave group tuning and directive systems are now available, it is not difficult to foresee that this comparatively new method of communication is destined to fill a position of the greatest importance in facilitating communication throughout the world.

TRADE STATISTICS OF SOUTH AFRICA.

The following statement, showing the imports of electrical and similar goods into British South Africa during the year 1910, has been taken from the recently issued official trade statistics. The figures for 1909 are added for purposes of comparison, and notes of any increases or decreases are given :—

	1909.	1910.	Increase or decrease.
Detonators.—	£	£	£
From Great Britain ..	19,000	27,000	+ 8,000
,, Germany	10,000	8,000	— 2,000
Total ...	29,000	35,000	+ 6,000
Fuses.—			
From Great Britain ...	55,000	81,000	+ 26,000
,, Germany	52,000	46,000	— 6,000
Total ...	107,000	127,000	+ 20,000
Asbestos manufactures.—			
From Great Britain ...	300	700	+ 400
,, Other countries ...	—	500	+ 500
Total ...	300	1,200	+ 900
Brass manufactures.—			
From Great Britain ...	15,000	21,000	+ 6,000
,, Germany	1,000	1,000	—
,, Other countries ...	1,000	2,000	+ 1,000
Total ...	17,000	24,000	+ 7,000
Copper, plate and sheet.—			
From Great Britain ...	4,000	5,000	+ 1,000
,, Germany	1,000	1,000	—
Total ...	5,000	6,000	+ 1,000
Copper manufactures.—			
From Great Britain ...	3,000	3,000	—
,, Other countries ...	1,000	—	— 1,000
Total ...	4,000	3,000	— 1,000
Electrical cable and wire.—			
From Great Britain ...	120,000	182,000	+ 62,000
,, Germany	79,000	75,000	— 4,000
,, United States ...	5,000	4,000	— 1,000
Total ...	204,000	261,000	+ 57,000
Electrical fittings, including posts.—			
From Great Britain ...	66,000	118,000	+ 52,000
,, Germany	84,000	215,000	*+131,000
,, Holland	3,000	2,000	— 1,000
,, United States ...	15,000	21,000	+ 6,000
,, Other countries ...	2,000	4,000	+ 2,000
Total ...	170,000	360,000	+ 190,000
India-rubber of all kinds.—			
From Great Britain ...	28,000	30,000	+ 2,000
,, Germany	3,000	2,000	— 1,000
,, United States ...	3,000	3,000	—
Total ...	34,000	35,000	+ 1,000
Lamps and lampware.—			
From Great Britain ...	14,000	19,000	+ 5,000
,, Germany	12,000	14,000	+ 2,000
,, Sweden	1,000	1,000	—
,, United States ...	7,000	10,000	+ 3,000
,, Other countries ...	—	2,000	+ 2,000
Total ...	34,000	46,000	+ 12,000
Machine bands and belting.—			
From Great Britain ...	103,000	131,000	+ 28,000
,, United States ...	27,000	24,000	— 3,000
,, Other countries ...	1,000	1,000	—
Total ...	131,000	156,000	+ 25,000
Electrical machinery.—			
From Great Britain ...	111,000	254,000	+143,000
,, Germany	103,000	480,000	*+377,000
,, United States ...	45,000	71,000	+ 26,000
,, Other countries ...	2,000	5,000	+ 3,000
Total ...	261,000	810 000	+549,000

* Large increases, mostly due to supplies for Victoria Falls Power Works.

Cranes, elevators and lifts.—			
From Great Britain ...	19,000	73,000	+ 54,000
,, United States ...	2,000	2,000	—
,, Other countries ...	—	3,000	+ 3,000
Total ...	21,000	78,000	+ 57,000
Mining machinery.—			
From Great Britain ...	673,000	910,000	+237,000
,, Germany	114,000	161,000	+ 47,000
,, United States ...	161,000	164,000	+ 3,000
,, Other countries ...	10,000	16,000	+ 6,000
Total ...	958,000	1,251,000	+293,000
Machinery not specially mentioned (other than agricultural, manufacturing, &c.).—			
From Great Britain ...	301,000	466,000	+165,000
,, From Germany ...	33,000	32,000	— 1,000
,, United States ...	23,000	41,000	+ 18,000
,, Other countries ...	4,000	13,000	+ 9,000
Total ...	361,000	552,000	+191,000
Railway rails.—			
From Great Britain ...	107,000	33,000	— 74,000
,, Belgium	44,000	76,000	+ 32,000
,, Germany	47,000	71,000	+ 24,000
,, United States ...	1,000	3,000	+ 2,000
Total ...	199,000	183,000	+ 16,000
Telegraph and telephone material.—			
From Great Britain ...	12,000	6,000	— 6,000
,, Germany	1,000	2,000	+ 1,000
,, Sweden	2,000	3,000	+ 1,000
,, United States ...	—	2,000	+ 2,000
Total ...	15,000	13,000	— 2,000
Tramway rails.—			
From Great Britain ...	2,000	10,000	+ 8,000
,, Germany	16,000	7,000	— 9,000
,, United States ...	2,000	24,000	+ 22,000
Total ...	20,000	41,000	+ 21,000
Tramway rolling-stock.—			
From Great Britain ...	4,000	17,000	+ 13,000
,, Germany	2,000	—	— 2,000
,, United States ...	1,000	2,000	+ 1,000
Total ...	7,000	19,000	+ 12,000
Other tramway materials.—			
From Great Britain ...	3,000	15,000	+ 12,000
,, Germany	10,000	1,000	— 9,000
,, United States ...	1,000	5,000	+ 4,000
,, Belgium	—	3,000	+ 3,000
Total ...	14,000	24,000	+ 10,000

ELECTRICAL ACCIDENTS IN 1910.

THE report of the Electrical Inspector, Mr. G. Scott Ram, to the Home Office, has just been published for the year 1910, the first during the whole of which the new Regulations were fully in force. The Inspector states that some questions have arisen during the year as to whether certain forms or conditions of the transformation or conversion of electrical energy constitute "electrical stations" within the meaning of the definition, thereby bringing the premises or any part thereof under the Acts and Regulations. Thus, electrical energy taken from public supply mains is passed through motor-generators, converters or rectifiers, for use in cinematograph lanterns, or for the charging of secondary batteries. So long as the use of the transformed or converted energy is solely for the purpose of throwing pictures on a screen or for charging batteries, the transformation clearly does not fall within the definition. There are other Regulations under a special Act dealing with cinematograph exhibitions including the electrical plant. Of course, if the transformer or converter is on premises already under the Acts, as in motor-car repair shops where batteries are charged, the Regulations will apply.

With regard to the observance of the Regulations generally, while many occupiers have taken trouble to ascertain if their installations are in conformity with the requirements, and have taken steps to put them in order where necessary, a large number have done nothing, pending instructions from the Inspectors, although it is the duty of the occupier to provide compliance without waiting for instructions. Reports from some of the Inspectors show, however, that a good deal of work has been done in getting some of the more obvious defects remedied, such as bare conductors, fuses, switches, &c., protected, defective switches, &c., repaired.

Mr. Evans (Glasgow) reports that apparatus recently installed in most cases is in conformity with the requirements. In some cases of new installations small occupiers seem to have been taken advantage of by their electrical contractors getting rid of surplus stock which failed to comply with the requirements, the occupier having omitted through ignorance or otherwise to stipulate that the apparatus must comply with the Regulations; but these cases are fortunately not numerous. Fuses designed so that the fusible metal cannot be renewed without danger, and having no switch in series, appear to have been very extensively installed in the past, thus making breaches of Regulation 5 very common. The minor accidents, chiefly burns, have in the main occurred at the starting gear of D.C motors, owing to the lever of starting resistance sticking at the "on" position, and a short circuit being caused when line switch is closed without noticing this; or through the use of a certain defective type of enclosed double-pole switch, a short circuit being made by an arc across the switch terminals when the switch is opened. In this district, where some very extensive alternating systems supply large areas, almost all the accidents have occurred on direct-current apparatus.

Mr. Ram points out that this last observation is applicable generally. Whilst more accidents causing burns occur with direct-current apparatus, the fatal shock accidents are nearly all with alternating current.

Mr. Good (Birmingham) reported that irregularities were principally the failure to protect exposed live parts and provide for the earthing of parts liable to become charged.

Mr. Barlow (Wolverhampton) said that defective springs and weak magnetic (no volt) releases had often been found tied back; broken porcelain fuse covers were common. The first-aid notice (Reg. 29) was often neglected.

In some districts the Corporation's own rules are more strict than the Regulations, and consequently the latter are well carried out; in some cases the electrical supply authorities have altered their own regulations to coincide with those under the Factory Acts. It is certainly to the advantage of the occupier when the supply undertakers look carefully after his installation. This supervision is not, however, universal; there are others, some being local authorities, who do not trouble about their consumers' installations in any way beyond making an insulation test before starting to give a supply. Further than this, some even hand over to the occupier the care of their service fuses.

At a large installation, several hundred horse-power being taken from the mains of the Corporation, the main fuseboard had no cover and was left open to the occupier, expressly so that he might renew the service fuses at any time. The person renewing a fuse would be in danger of shock, and would run great risk of making a short circuit on the mains and being severely burned. Ordinarily service fuses are sealed up by the supply authorities, and are exempt from the Regulations under Exemption 2. If, however, the occupier has access thereto, necessitating the exposure of live metal, the exemption does not apply, and the Regulations must be complied with. The fuse gear usually provided by supply authorities is not safe for the occupier to handle. As the service fuses are necessarily provided and installed by the supply authorities, the latter must see that the Regulations are complied with in all cases where they allow the occupier access, particularly that he shall be enabled to renew the fuses without danger (Regulation 5), renewal being the only object in view in not placing the fuses under seal.

Mr. Ram has come across some important plants, put up since the Regulations came into force and by well-known firms of electrical contractors, where the Regulations have evidently not been taken into consideration. Two of these were 440-volt three-phase installations of considerable size. In both cases such definite requirements as space at the back of the main switchboards had been overlooked, 18 in. instead of the required 3-ft. passage being provided. In one case his visit was the outcome of an accident which occurred behind the switchboard, and which was probably due to the restricted space. In another case the work had been put in under the supervision of a consulting engineer. Unfortunately for the occupier in such cases, it is he who is responsible under the Factory Acts, and not the defaulting contractor or engineer.

If there is no danger, the Regulations are observed, as even where the definite requirements are not carried out, if the occupier can show that the special conditions in his premises are such as adequately to prevent danger, there is no contravention.

In his report for 1908, Mr. Ram described how a connector-plug should be made to obviate danger, with the idea that any manufacturers should be able to make it if they wished. Several are now making it, but an attempt was made during the year by one firm, by applying for a patent, to annex it for their own benefit. The sealing of the patent was, however, successfully opposed by the Home Office in the interest of the public, and consequently no patent has been granted.

Fuses, unless protected by a switch cutting off all pressure, must be designed so that they may be handled with safety for the purpose of renewing a fuse, and this is a point which has been overlooked in many of the patterns commonly met with. There is a tendency to the use of fuses or switch-fuses for very large currents under conditions where circuit-breakers would undoubtedly be safer and more suitable. A type of fuse which has recently come into considerable favour has a porcelain cartridge fitting into contacts enclosed in a porcelain base. It is arranged so that it can be handled for renewal without danger of touching live metal, but it is not intended for use as a switch-fuse. It has an indicator for showing when a fuse has blown. One of the chief features is that the proper size of fuse for the circuit having been determined upon, the base is set to take that size of cartridge and no other. It is impossible for an unauthorised person to over-fuse the circuit by inserting a fuse of larger capacity. The cartridges contain the smallest possible amount of metal in the fuse, with the result that they break circuit without report or explosion under very severe conditions.

Many types of direct-current circuit-breakers are dangerous, particularly when used in confined spaces such as the driving cabins of cranes, through exposed live metal and from the flash or scattering of hot particles of metal when they come into operation. Enclosed circuit-breakers designed to overcome these defects have now been produced.

There have been instances of explosions of oil switches resulting in the oil tanks being shattered, and other damage being done. The switchbox should be so constructed as to prevent the accumulation of any gas in the space above the oil.

Unsatisfactory and dangerous work is often due to the cutting of prices and acceptance of the lowest tender. Mr. Ram recently saw a new installation which, although supplied by a well-known firm, showed the extent to which the striving after cheapness could be carried. The supply was from public mains, and the switchboard had to provide for a number of circuits for motors and lighting. The switches were arranged, in order to save a little in copper connections at the back of the board, so that when in the "off" position the projecting blades were live. They were so close together that it was impossible to operate any switch without touching the live blades of the adjacent ones. Although the board had only been in use for a few days at the time of his visit, several of the switches had broken on account of their weak construction. On pulling a fuse-holder out of the fixed contacts, the latter proved so flimsy that they took a permanent set out from the slate. The slate itself was of a conducting nature, and a shock could be felt off any of the conductors when the main switches were "off." The distribution from the switch-house to the surrounding buildings was by overhead wires, in order to effect a very small saving. The poles, consisting of sawn timber, were cut so fine that those on the bends were in danger of breaking off at the points where the stay-wires were attached.

With regard to public supply stations, in several instances new main switchboards have been put in, and in others steps are being taken to that end. In these cases the station engineers have been very glad of the assistance afforded them by the Regulations in obtaining the necessary grants for carrying out the alterations.

One of the most important of the Regulations (No. 28) provides against the employment of (technically) ignorant persons where there is danger. Arising out of fatal accidents, two prosecutions under Sec. 136 were undertaken against electric power companies for breaches of this and other regulations. In one case the company was fined £20; in the other, a fine of £10 was imposed. An (electrically) ignorant person, whether an unskilled labourer or a skilled artisan, cannot realise the danger to which he is exposed. If it is necessary to employ such persons near live conductors, the live conductors must first be so screened off that there is no danger. If work has actually to be done under conditions where there is danger, then a competent electrical engineer or other person with adequate technical knowledge should undertake it.

(*To be continued.*)

Conduit Manufacture in Australia.—A firm in New South Wales desires to get into touch with a British manufacturer of machinery for manufacturing ordinary and brazed mild steel unscrewed electric conduits. Communications should be addressed to the Agent-General in London for New South Wales, 123-5, Cannon Street, E.C.—*Board of Trade Journal.*

LEGAL.

Hartlepool Electric Trams Co., Ltd., and Sellon and Ashby *v.* The Mayor and Corporation of West Hartlepool.

On June 14th this action was heard before Mr. Justice Bray without a jury in the King's Bench Division of the High Court.

Mr. Atherley Jones, K.C., M.P., Mr. Eustace Hills and Mr. Tyldesley Jones appeared for the plaintiffs, and Mr. Balfour Browne, K.C., and Mr. H. A. McCardie represented the defendants.

Mr. Atherley Jones said the subject matter of the action came before his Lordship in May of last year in the form of a special case, when it was pointed out that the award of the Arbitrator was not in statutory form, and it was suggested that some arrangement should be come to between the parties so that the issue between them might be properly formulated. It had now been agreed that the value of the undertaking should be taken at £12,963, and the only question remaining was whether the purchase money was payable to the promoters, Sellon and Ashby, or to the Tramway Co., or to neither. In 1895 a provisional order was obtained authorising the construction of this tramway, and it was constructed by the Hartlepool Tram Co., or by the parent company, the British Electric Traction Co., in the name of the promoters, Sellon and Ashby. In March, 1898, the Board of Trade gave a certificate that it was duly completed. In January, 1910, the Corporation, acting under the provisions of the Tramway Act, 1870, and the Special Act, gave statutory notice of purchase by the Corporation. The promoters gave notice that the Hartlepool Trams Co. would act for them in the purchase negotiations, and eventually there was an arbitration to determine the value of the tramway. The dispute arose in this way. Under the Special Act, Sellon and Ashby were, and still remained, the promoters. Sec. 48 of that Act said, "No sale or assignment of the undertaking shall have any validity or effect until after the approval of the Board of Trade to such sale or assignment has been signified in writing signed by a secretary of the Board of Trade." There was no legal assignment, although there was an equitable assignment, because there was an agreement entered into by which Sellon and Ashby agreed to sell their interest to a prospective company, and then there was an agreement by them agreeing to sell the whole undertaking to the Hartlepool Trams Co. No sanction was obtained from the Board of Trade to that agreement, and therefore there was not, under the statute, any assignment. The contentions with which the plaintiffs were met in this claim to recover the £12,963 from the Corporation were these: That Sellon and Ashby were, and still remained, promoters of this undertaking under the statute, that they had not divested themselves of their status as promoters, but that they had at common law no property whatever in this tramway undertaking, and therefore they ought not to be paid for that which they did not possess. The second contention—the second horn of the dilemma on which defendants sought to put the plaintiffs—was that the tramway company were mere trespassers or strangers, inasmuch as no statutory assignment had been executed to them, and that whatever may be the rights between the tramway company and the promoters *inter se*, at common law or in equity, they had no statutory position which enabled the Court to recognise them as persons to whom the purchase money of the tramway should be paid. His submission could be stated in a few words: It was that it was quite immaterial for the purposes of his Lordship's decision what operations may have been performed by the promoters in respect of their ownership of this line. It was quite immaterial whether or not they found the resources for the construction of the tramway. It was quite immaterial, so far as the Corporation were concerned, what arrangements, financial or otherwise, might have been entered into by the promoters with regard to the construction of the line. So far as the Corporation was concerned, the promoters were the only persons who could give a good title to the Corporation by transfer, and the promoters were the only persons who were entitled to receive payment. No effective claim could be made against the Corporation for payment by any other person than the promoters. The Corporation could acquire a good title by payment to the promoters, and it was wholly immaterial what might be the destination of the fund, so long as the statutory conditions under which the Corporation acquired the tramway were complied with. That being so, he submitted that if payment was made to the promoters by the Corporation that was all that concerned the Corporation. They could not be affected hereafter in the smallest degree. Nothing whatever had been done by the promoters to put them under any disability in carrying out their statutory contract with the Corporation. Of course, the tramway company did not set up any claim against the Corporation in contradistinction to the claim by the promoters.

Mr. Balfour Browne, for the Corporation, said the position taken up by his learned friend was entirely different to that he had taken on the last occasion. Then he said he appeared for the company, but now he said he appeared for the promoters.

Mr. Atherley Jones said he appeared for both parties.

Mr. Browne said the Board of Trade had said that the company had no *locus standi*, and Mr. Sellon himself had admitted in evidence that he had parted with all his rights in the undertaking, and that he had acted simply as the engineer to the company. It was obvious they could not treat that gentleman a promoter. The promoters had lost their rights by not using the tramway, and the company had not got the assent of the Board of Trade to the assignment. The Corporation had agreed that £12,963 was the value of the undertaking, but they were now asked to pay that sum to gentlemen who had no part in the concern.

His Lordship: Do you say the Corporation have no power to sell?

Mr. Browne said he thought if the Corporation paid the promoters, they would be surcharged by the Board of Trade.

His Lordship said he thought all he could do was to make an order for specific performance. He could not order the payment of the money.

Mr. Browne said the claim in the writ was for £12,963 in cash.

His Lordship said he could amend the claim.

Mr. Browne said all the Corporation had agreed to, was that the value of the tramway undertaking was £12,000. His Lordship could not order specific payment of a sum of money unless they knew to whom the money was due.

His Lordship: It must be paid to the promoters.

Mr. Jones said he thought it should be an order for specific performance of the agreement for the purchase of the undertaking authorised by the Hartlepool Electric Tramway Order of 1895, created by the service of the notice under Sec. 43 of the Act of 1870, and Sec. 46 of the Provisional Order of 1895, served on the plaintiffs on June, 1910, and the agreement as to the value thereof made on May 10th, 1911.

His Lordship: To whom does this tramway belong?

Mr. Browne: To nobody. The promoters have sold their interest for £900 by their own admission.

His Lordship: The question in law is who has power to work the tramway?

Mr. Browne said he thought the power to work the line had ceased because it had never been exercised by the promoters. The plaintiff company might have property in the rails if they chose to take them away. He thought the only cure for the matter was for the plaintiffs to get a prov. order or an Act of Parliament to say that the transfer made for the promoters with the company was good, and then the Corporation would at once pay over the money.

Mr. Jones did not think a prov. order was necessary; all they needed was the sanction of the Board of Trade.

Mr. Browne said the time had gone by for that, as there must be certain notice under the Act.

Mr. McCardie followed his leader on the legal points, and Mr. Jones replied.

His Lordship said he would take time to consider his judgment.

National Telephone Co., Ltd. *v.* His Majesty's Postmaster-General.

In the Court of Appeal on Wednesday last week, before the Master of the Rolls and Lords Justices Farwell and Kennedy, this case was heard upon the cross-appeals of the Crown and the company from a judgment of the Railway and Canal Commission.

The facts have already been detailed in our previous reports.

In the Court below, Mr. Justice A. T. Lawrance held that the notices in regard to the three London Exchanges were good, but that the others were bad. The latter, he said, were too vague, and it was no answer to say that it would have been difficult to have stated more explicitly in the notices the plant, &c., objected to. The Hon. Gathorne Hardy concurred in the judgment of Mr. Justice A. T. Lawrance, but Sir J. Woodhouse, the other Commissioner, differed, being of opinion that the whole of the notices were good. Hence the present appeal of the Postmaster-General.

The Attorney-General, the Solicitor-General and Mr. Branson appeared for the Postmaster-General; and Sir A. Cripps, K.C., Mr. Danckwerts, K.C., Mr. Morten, K.C., Mr. Forbes Lankester, K.C., and Mr. Gaine for the Telephone Co.

The Attorney-General, opening the case for the Postmaster-General, said the matter in dispute arose out of the agreement made between the Postmaster-General and the National Telephone Co., dated February 2nd, 1905, and the question their Lordships had to determine was what view they took of certain clauses in the agreement. There were substantially two points involved in the appeal. One was as to the validity of certain notices of objection under the purchase agreement, and the other was as to the meaning of certain words in the agreement. The particular point involved in the appeal was whether the Postmaster-General was right in saying that he was not bound to take over plant which was duplicated. In other words, it was said that the Postmaster-General was not bound to take over plant which was unsuitable for his requirements, because he had already plant there which was sufficient to supply the wants of the subscribers. The matter which came before the Railway and Canal Commission, was in the nature of an interim application which became necessary in order to determine certain questions for the preparation of an inventory which had to be made, and upon which they had to determine the amount to be paid for the plant, &c., to be purchased. The points he had indicated were the only points to be determined upon the present appeal. Whatever the result of the appeal was, they had to go back to the Railway and Canal Commission on the application, in order to determine questions of fact of considerable complexity which were involved in the judgment. For that reason, said counsel, it was necessary to get the opinion of the Court on the points involved. The Attorney-General submitted that the notices given were valid. There was no provision either in the agreement or in any statute which imposed upon the Postmaster-General an obligation to give notice in any special form. All that had to be done was to give notice of objection, and it was sufficient if a notice was served which

would show what was objected to. If the company's argument were to prevail, an impossible burden would be imposed on the Postmaster-General. It was true that if he had agreed to undertake the burden this would be no answer, but in construing an agreement that construction ought to be adopted which would not impose an impossible burden on one party.

Even assuming that the notices were not sufficiently precise, the remedy was for the Court to direct further particulars to be given. What the Court had done was to declare that the notices were void. His submission was that it was not open to them to decide that the Postmaster-General was wrong, not because he was wrong on the merits, but because the notices that he had given were insufficient.

As to the construction to be put on Clause 3, what had to be considered was, first, the meaning of the word "suitable" in itself; and, secondly, its meaning in the collocation "suitable to the actual requirements of the telephonic service of the Post Office." The word in itself obviously applied to quantity as well as quality. The criticism that he made on the judgment of the majority was that they had confined the meaning of the word to character only. He did not dispute that it applied to character, but it also applied to the quantity of the plant. But the question was what was meant by the words "suitable for the actual requirements of the telephonic service of the Post Office?" The test to be applied was whether the plant of the company was suitable for the actual requirements of the Post Office.

In the case of competitive areas, when there was a duplication of plant, plant of the company which would not be necessary for the carrying on of the service by the Postmaster-General was not suitable for his requirements.

Sir Alfred Cripps, in the course of his argument for the Telephone Co., said that Sub-Clause (*a*) of Clause 3 applied to both competitive and non-competitive areas. It was most important to bear in mind that, as regards *a*, the test was whether the plant was of the prescribed construction or specified in the list in the schedule to the agreement. No objection could be taken to plant in the list even if it was not constructed according to the specification. Then by *b*, in the competitive areas, what was taken out of *a* was plant, whether constructed according to specification or not, if it was not suitable to the Postmaster-General's system at a particular date.

As for land and buildings, land was not to be bought, and buildings were not to be constructed, after 1905, without the consent of the Postmaster-General; but in the case of competitive areas, the assent did not protect the company if the buildings were not suitable. It was easy to see that it could be contended that buildings were not suitable to the business that the Postmaster-General proposed to carry on. It was admitted that plant in the list could not be objected to under *a*. All that *b* provided was that construction, according to the specification, was no longer a protection to the company. That did not give the Postmaster-General the right to object to plant in the list as unsuitable to his requirements.

The test of suitability was suitability to the system of the Post Office on a particular day. That excluded suitability to the company's system. Suitability, therefore, had to be considered with reference to that limited test, and if in these circumstances it were construed as meaning necessity, the result would be absurd because no portion of the company's plant could be said to be necessary to the Post Office.

With regard to the notices, it must be remembered that the onus was on the company to obtain an award before a certain date that plant objected to was suitable. The notice, therefore, ought to be such that a reasonable business man on receiving it could decide whether it should be accepted or not, having regard to his business interests.

(*To be continued.*)

CAVEHILL TRAMWAY PURCHASE.

LAST week, in the King's Bench Division, Dublin, the Lord Chief Baron, Mr. Justice Kenny and Mr. Justice Wright, had before them the matter of an arbitration between the Corporation of Belfast and the Cavehill and Whitewell Tramway Co., in which an application was made on behalf of the Corporation for an order setting aside the award of the Arbitrator, Mr. Lynden L. Macassey, dated March 30th last, on the ground that the arbitrator, by an alleged mistake in law, and in excess of jurisdiction, improperly construed the words "the transferred undertaking," contained in the agreement embodied in the Belfast Corporation Tramways Act, 1910, to mean something other than and different from its true meaning—namely, the transferred undertaking as a going concern."

The arguments having been concluded, judgment was reserved.

E.M.F., LTD., *v.* SPINK.

IN the Lord Mayor's Court on June 14th, before the Recorder and a jury, plaintiffs made a claim against Mr. Fred Spink, said to be carrying on business at Earl's Court, to recover the sum of £21 8s. 9d., the price of goods sold and delivered to Mr. W. Barnes, electrical engineer, trading as W. Barnes & Co., at 12, Kenway Road, Earl's Court. The plaintiffs claimed that the money was due from the defendant under an agreement in writing relating to the sale of goods to Mr. Barnes.

MR. KOPPELL appeared for the plaintiffs, and said that on or about February 7th, 1910, they received a letter from the defendant, in which he said, "as Mr. Barnes is anxious to open, if you will send him on the goods to-morrow, I will see your account is settled during the week. He has some money due, and is daily expecting it." Goods of the total value of £69 18s. 2d. were supplied to Mr. Barnes, and the amount now sued for is still owing. In the defence which he had set up, the defendant denied that he had ever guaranteed the payment of any account for goods supplied to Mr. Barnes.

The RECORDER said he could not see that the letter written by the defendant was a guarantee to pay the account.

MR. KOPPELL pointed out that, since writing the letter, the defendant had paid the plaintiffs two sums of money in respect of goods sold to Mr. Barnes.

In the absence of the defendant, the RECORDER directed the jury to return a verdict for the plaintiffs for the amount claimed, and judgment was entered accordingly, with costs.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"ELECTRIC SUPPLY" writes: "Can a Parish Council grant permission to a small company to establish an undertaking for private and public supply in their district, allowing free wayleaves throughout their district for a term of years, and also granting the company rights to apply for Parliamentary powers, should the company desire, any time during the term of agreement?"

*** The older Electric Lighting Acts, viz., those of 1882 and 1888, place no restriction on the establishment of electrical generating stations by anyone. Provided the traffic along roads was not interfered with, and provided the necessary way-leaves could be obtained, any man might supply electricity to his neighbour on any terms he chose. Now, however, by the Electric Lighting Act, 1909, no-one can supply electricity in any district if there is already a provisional order there in force, unless the supply is given incidental to the main business of the person granting the same. In this respect monopoly ceased to exist when the Act of 1909 became law. "Electric Supply" does not say whether there is a supply authority in his district. If there is not, and the proper authority sanctions the laying of pipes beneath highways, &c., there seems to be no reason why he should not grant a supply in the manner suggested.

SOME OBJECTIONS TO "FREE WIRING"

BY H. E. GOODY.

A LARGE number of supply authorities have dabbled in a variety of free-wiring systems. Some have experimented with the policy for a few months, and have then dropped it, or, at any rate, refused to extend it. Others, with a persistence worthy of a better cause, continue in the vain hope of recovering the capital which they have so generously spent in wiring other people's houses.

Free wiring brings about a rapid increase in the number of consumers; but consumers gained through its agency are generally those least worth having. The free wiring consumer is, as a rule, the occupier of a three or four roomed house or flat; and obviously the average consumption of this class of consumer must be very low. As ordinary consumers they would pay well enough; but as free wiring consumers they involve a capital charge which can never be repaid from their small disbursements for electricity.

An electric light installation has too short a life for the company to be content merely to earn interest of, say, 6 or 7 per cent. on their capital outlay; for the system to have the slenderest chance of financial success, it is necessary that each installation should be completely paid for in, at the most, four years. And that, entirely by means of the extra amount per unit which the free wiring consumer pays over and above that paid by the ordinary consumer. Four years is set as the limit, because by that time the most expensive portions of the installation, viz., fittings, transformer and lamps, will probably need renewal; the lamps, of course, will have been renewed several times within that period. These items represent approximately three-quarters of the total cost of the installation.

It is submitted that most free wiring systems do not comply with the conditions of capital repayment indicated above, and are, therefore, financially unsound.

A fairly typical system is the one worked by a certain municipal undertaking. The houses are wired and fitted by contractors at a uniform charge to the Borough Council of £4 for 7½ points (the three-light fitting in the front room counting as 1½ points). The Council fixes transformers and

supplies 50-volt metal-filament lamps. The ordinary prepayment charge in the neighbourhood is 4½d. per unit; by the free wiring system it is 6d. The total cost to the Council is from £5 10s. to £6 for each installation, apart from the cost of cable extensions which would not have been made for ordinary consumers without a substantial guarantee.

Over a winter's quarter, it was found that the average weekly amount put by each free-wiring consumer into his prepayment meter was approximately 1s. That represents an average weekly consumption of 2 units of electricity. As the ordinary prepayment charge is 4½d. per unit, only 3d. from the 1s. can be credited to capital repayment. Allowing for a smaller summer consumption, one may say roughly that the average free-wiring consumer in this neighbourhood pays the Council 8s. per annum for his installation, including repairs and lamp renewals.

Leaving out lamp renewals (which alone would absorb more than 8s.) and repairs, it would take at this rate almost 14 years to repay the bare original cost. And, of course, there are other trifling contingencies which might lengthen this period almost indefinitely; the freely-wired house might remain empty for a considerable time, or new tenants might refuse to use the electric light.

How the system would pay if it were applied to the premises of large consumers, such as shopkeepers, is doubtful: but it would obviously have a better chance of success than in the case of small houses. Every point installed in a shop is in constant use; every lamp earns its quota of revenue. But large consumers will not go in for such a system, realising that if it pays the supply authority to wire their premises on such terms, it will pay them to do their own wiring.

No! the fact must be faced that free wiring will only attract the small consumer; and it will only attract him so long as the conditions are such that there is no possibility of the system being financially successful from the supply authority's point of view. It would seem that 8d. or 9d. per unit (in large towns) is about the figure necessary to secure a fair and adequate rental for installations in small houses. But at this figure electricity is much too expensive.

To cite the Gas Light and Coke Co.'s system of supplying fittings and stoves, in return for which consumers pay an increased charge of 9½d. per 1,000 ft. of gas, as a reason why electrical free wiring should pay at a proportionate extra charge per unit, is absurd. The cases are not parallel. The Gas Co. does not put in any pipework; it simply supplies three or four pendants or brackets, worth about 2s. 6d. each, and a gas cooker worth 30s. or £2. The Gas Co.'s property does not exceed £2 10s. in value in small houses; and its lights, and especially the stoves, are all revenue producing. It takes very good care not to fix fittings in bathrooms or sculleries, as was done by the generous electric light authority referred to above.

The Gas Light and Coke Co., when it started its system of free installations, entered on a glorious heritage of previously laid gas pipes; electric light authorities, when they go in for free wiring, have to install everything. The gas company puts 1d. burners on its fittings; electric light authorities supply 2s. 6d. metal-filament lamps. And yet, in spite of these big differences, both make approximately the same extra charge for their free installations.

There are free-wiring systems in which, instead of there being a combined charge for current and installation, there is a separate quarterly rental for the installation. This has the advantage of securing to the supplier regular repayments of its capital outlay, quite independent of the amount of energy consumed; but it has the obvious drawback of complexity. People like to pay lump sums; they object to being charged so much for current, and so much for installation rental. And with this method the same thing holds—that, if you charge a large enough rental to make the system pay, you also make the system quite unattractively expensive.

Free wiring does not pay the supply authority, and it does not benefit the consumer, who has to pay through the nose for something he ought not to have to pay for at all. It is the landlord's business to wire his premises for electric light; and electric light suppliers, with their free-wiring schemes, are simply turning themselves into philanthropic institutions for the assistance of mean and unenterprising landlords.

Apart from the obvious injustice of consumers having to pay for the wiring at all, there is the further objection that the method of charging is monstrously unfair. It penalises the large consumer. Take a case where an extra free-wiring charge of 2d. per unit is made. The man who consumes 50 units a year pays 8s. 4d. during that period for the use of the installation; but the man who consumes 100 units pays 16s. 8d. for precisely the same thing. In most commercial transactions the big customer gets preferential treatment in the form of rebates.

This principle, which underlies both electric light and gas free installation systems, of a fluctuating charge for a thing of constant value—a charge, moreover, of which the fluctuations are in favour of the small, and against the large, consumer, will have to go if the systems are to survive.

Personally, the writer hopes that the unfair method of charging will be retained, so that from this and other causes free wiring will come to an early and merciful end.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Channel-Iron Poles.

Referring to Messrs. Armstrong, Addison & Co.'s criticisms of my notes on channel-iron poles (June 16th issue), I would point out that the statements made were naturally those advanced in the Continental article, of which my notes were an abstract.

Personally, I am in perfect agreement with their remarks, but there is, nevertheless, a wide field of utility for the special construction in question.

R. E. Neale.

London, *June 16th*, 1911.

Aerial Telegraphs and Factors of Safety.

I am indebted to the gentleman who wrote such an interesting letter to the ELECTRICAL REVIEW for June 9th, 1911, concerning the above subject, from far-off "Chile."

In its initial stage, the article was written to indicate the best practice in the construction of aerial telegraphs on English railways; it is certainly a wise precaution to modify those suggestions as required to comply with the conditions encountered in foreign lands.

For ordinary structures not exposed to sudden shocks, a strength equal to four times the highest stresses they have to meet has been found sufficient for our purpose; that is, a factor of safety of 4 is allowed. The Post Office stipulate that for structures exposed to shocks when loaded, factors of 8, 10 or even 12 become necessary; but if such a provision were to become the general rule and not the rare exception, the erection of aerial lines in this country would be impracticable, and underground work would become imperative.

Suppose a railway accident occurred on the main line and the derailed vehicles were piled alongside the telegraph route, breaking all the wires in the vicinity. The only precaution taken against such a contingency is to provide longitudinal stays every fifth span—or thereabout—thus minimising the area of damage.

Fortunately, this country is not troubled with cyclones and whirlwinds, nor has the writer had any practical knowledge respecting them, but if it be true that, at such times, trees of the forest are torn up by the roots, and that buildings usually collapse like a pack of cards, it may be presumed that poles and wires would suffer in the general demolition, regardless of the ordinary factors of safety.

The risk of contact would, perhaps, be reduced by lowering the factor of safety as suggested, but the wires would obviously be less capable of withstanding any abnormal stresses to which they might be subjected; moreover, there is

much to be said against long spans, and such procedure is a false economy from whatever standpoint the subject be impartially viewed.

Reference has been made to contacts through kite tails becoming entangled in the wires. Perhaps the railway company with which the writer is identified suffers the maximum inconvenience from this cause, but an alteration in the sag of the wires would not be a solution to the difficulty. In the homeland experience has shown that a full contact is preferable to an incipient earth, or partial contact, since a complete stoppage on one wire necessitates the speedy removal of the fault, whereas an intermittent interruption is more difficult to locate, and is apt to bring about the transmission of false block code signals.

The Writer of the Article.

The Telephone Transfer.

The views of Mr. Hirst on this subject, so fully expounded at the meeting of a manufacturing company, and so widely circulated in the Press, deserve some comment. It may be, perhaps, considered cynical to suggest that those views are somewhat coloured by a lively sense of orders to come; but I am impelled to that suggestion, both because Mr. Hirst's published opinions are in direct opposition to those of almost every member of the electrical industry having knowledge of the subject, and of most of the technical, financial, and lay Press, and because the Post Office looks like being the only future customer in this country for the company for which Mr. Hirst was speaking.

As a business man Mr. Hirst should find some difficulty in advocating so ardently the transfer of a business which under commercial management is operated at 58 per cent. of the gross receipts, to a department which operates the same business at over 74 per cent. of the gross receipts. The difference represents over 3 per cent. on the capital employed, which much more than offsets the lower rate of interest at which Government can raise capital, as compared with a company or a telephone authority.

The telephone service is at present very little developed in this country, a state of affairs which *is*—Mr. Hirst to the contrary notwithstanding—very largely the fault of the Post Office, as the Post Office telephone policy has been obstructive from the very beginning.

To accelerate the development of the telephone, which has been artificially restricted for years past, requires large expenditure of capital. Mr. Faithfull Begg, in a recent paper before the London Chamber of Commerce, put the capital required for the next 10 years to develop the telephone adequately in the United Kingdom at £116,000,000. Is it likely that the Post Office, which earns a bare 3 per cent. on its telephone business, will be able to induce the Treasury or Parliament to invest any such sum in a Government telephone monopoly? It may be argued that when the National Co.'s business is taken over the telephone profits of the Post Office will be greatly increased. So they will—for a year or two. But in time the same causes—relentless as the tides which have turned the telegraphs into a losing business—will wipe out the telephone profits. It is only a matter of time, if the telephone becomes a Government monopoly, when the Postmaster-General of the day will tell a thin and bored House that the telephones, like the telegraphs, are "past praying for."

As to pushing the telephone business, if that were not done by a trained business department much confusion would result. One powerful argument for a telephone authority is that under such management the very important question of business relations with the public would be adequately dealt with.

Herbert Laws Webb.

London, S.W., *June 17th*, 1911.

Notice to English Firms.

A person calling himself W. C. Rogers has been visiting various firms in the North of England and inviting them to send us circulars and price lists, saying that we are in the market for their goods. He also adds a tale that he used to be here, but had to leave on account of trouble with his eyes.

We have never heard of this person, and his tale is quite untrue. His last address is from a firm at 10, Arcade, Westgate, Bradford.

If you can find room to insert this in your paper, it may probably save much annoyance to these firms.

The Mansourah Electric Supply Company.
T. O. Mullings.

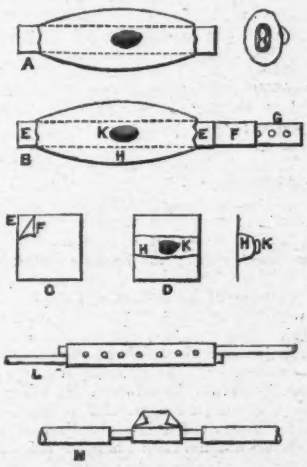
Mansourah, Egypt,
June 8th, 1911.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

New Soldering Devices.

A number of very ingenious devices for soldering joints in wires, the invention of Mr. Egner, of Stockholm, are being introduced by the Sloan Electrical Co., Ltd., of Conradty House, 12, Golden Lane, E.C. The essential idea of these novelties is the combination of the necessary solder and flux to make a joint, with an aluminium sheath; for large joints a brass or copper sleeve is added, with a cartridge or capsule of combustible material to supply the necessary heat.

Taking the last first, the appearance of the capsule is shown at A, below; the component parts are shown at B, pushed partly out of one another to indicate their nature and function. Here E is the aluminium sheath, F a sleeve of solder, G the tinned brass sleeve, H a mass of combustible, and K a patch of igniting composition. This is intended for jointing solid wires such as telegraph and telephone wires, out-of-doors, and is effectual even in wind and rain. The ends of the wires to be joined are slipped into the inner sleeve, the ignition composition is scratched literally on the box, and the heater at once commences burning like a fusee; when combustion is completed the joint is allowed to cool, after which the ash and the aluminium sleeve are stripped off, and the joint is left as shown at L, thoroughly soldered. This process was carried out by Mr. Hugo Tillquist, who has taken up the invention, in our presence, and the result was perfectly satisfactory. The holes seen in the inner sleeve are to allow the solder to enter the joint. We are informed that in tensile tests the wires never part at the joint, but always break outside it. The simplicity and convenience of the device for making joints in the field, without any accessory apparatus whatever, are obvious.



New Soldering Devices.

Smaller wires, flexibles, &c., are jointed with the thin flexible plates shown at C and D; here E is the aluminium sheath, cemented to the solder F with a resinous flux, with which the outer surface of F is also coated. One corner of F is here shown turned up to show both plates. In making a joint, the ends of the flexibles are twisted together, or in the case of solid wires they may be bound together with tinned wire, after which the soldering plate is bent double round the joint with the flux inside, and is squeezed tight on the wires as at M, the corners being doubled down to hold the plates securely; the joint is then heated with a small spirit lamp—or even with a match, in the case of small wires—and the aluminium sheath is afterwards removed. The plate shown at D is provided with a fusee H and cap K as in the case of A and B, so that no external source of heat is required. This process also results in a perfectly strong, sound joint. The advantage of dispensing with all soldering apparatus is obvious; nothing could be simpler or cleaner, and in many situations where joints have to be made these devices will be found most useful. They are made in various sizes to suit the different gauges of wire; those with the capsules are supplied for wires up to No. 11 S.W.G., and the plates for flexible up to '242 in. diameter.

HOLBORN STREET LIGHTING.

At the meeting of the Borough Council on June 14th the Special Committee on the subject of street lighting reported that they had considered the tender of the Gas Light and Coke Co. and the Metropolitan Electric Supply Co., Ltd., for the public lighting of the borough, by which approximately one half of the borough will be lighted by gas and the remainder by electricity. The companies undertake, for the payment of £6,950 per annum, to install and maintain suitable lamps and fittings, and to supply electric current or gas as necessary for giving a minimum light of 424,140 C.P. The scheme includes lamps of 1,800 C.P. in High Holborn, New Oxford Street, Kingsway, High Holborn crossing and Southampton Row to Vernon Place, Shaftesbury Avenue, distributed as follows:—High Holborn and New Oxford Street, 18 electric, 20 gas; Kingsway, High Holborn crossing and Southampton Row to Vernon Place, 2 electric, 26 gas; Shaftesbury Avenue, 21 gas. Lamps of 600 C.P. are to be placed in High Holborn and New Oxford Street, 13 electric, 8 gas; Tottenham Court Road, 20 gas. Electric lamps of 400 C.P. are to be placed in Brooke's Market, 2; Chancery Lane, 10; Gray's Inn Road, 54; Theobald's Road, 42; (Charterhouse Street, 13 gas); Holborn Circus, 4; Farringdon Road, 22; (British Museum Avenue, 6 gas); Clerkenwell Road, 28; Hart Street, 11; Bloomsbury Square (south side) 7; Vernon Place, 1; (Charing Cross Road, 12, gas); Great Queen Street, 13; Southampton Row (Vernon Place to Russell Square), 18. Lamps in the remaining streets are to be of 300, 180 and 90 C.P. In the specification upon which tenders were invited, the total C.P. required was 404,160, but the companies make certain suggestions which increase the total light to 424,140. The present cost of lighting by gas was £7,102 per annum, with a candle-power of 140,000. The gas company's tender of July last year was £6,688, with a C.P. of 260,000, and the same company's tender in January, 1911, was £7,527, with a C.P. of 405,000. The electricity company's tender in January last was £6,602, with a C.P. of 405,000. The report goes on to say that it should be borne in mind that none of the previous tenders were based upon a specification bearing the terms and conditions of a contract such as it is necessary, in the interests of the Council, to insist upon, and as between the two companies the tenders were not, for the purposes of comparison, on similar lines. They were merely the result of the companies' own ideas of what would be suitable improvements to make in the lighting of the borough, and of their calculations as to the extent to which the existing fittings could be utilised. The total figures given above were arrived at by adding the cost of the different lighting units, to obtain the approximate total cost for the gross candle-power required. The present tender is, however, made on a specification prepared by the borough surveyor, which was approved by the Council in March last, providing for all new lamps and fittings, and containing proper conditions for the protection of the Council in all respects, and on the basis of a 10-years' contract, determinable at the end of the fifth year by the Council on payment of £4,400 by way of fine, or smaller sums in subsequent years. In a letter which accompanied the last tender the companies stipulated, however, for the deletion of Clauses 28 and 35 in the specification, otherwise the annual payment would be increased 10 per cent. Clause 28 provides for the imposition of fines upon the contractors in the event of the nominal candle-power falling more than 10 per cent. on an average of 30 lamps taken on three succeeding nights. Clause 35 provides that the contractors shall adopt any subsequent improvement in burners, lamps or appliances that may be made, without additional cost to the Council. As regards Clause 35, in the Committee's opinion this condition is too onerous, and may well be deleted without prejudice to the Council's interests. The alterations in the schedule which were made by the companies with a view to bringing the lighting in certain streets into harmony with the lighting of adjoining boroughs, the Committee think should also be agreed to. They are strongly of opinion, however, that the provisions of Clause 28 should be adhered to. Negotiations have taken place with the companies on this point, but without any satisfactory result. The wording of the Clause is as follows:—"The candle power set against each lamp in the schedule shall be the minimum power as directly measured by the Council's photometrical apparatus placed at ground level, and in the event of same falling more than 10 per cent. below such minimum, the contractor shall be liable to a penalty not exceeding £5 for every occasion on which it is shown that the lamps are below the minimum candle-power, the average of 30 lamps taken on three succeeding nights to be taken as the basis of calculating the candle-power for this purpose. The term candle-power referred to in this specification shall have the same meaning as that given in the Gas Works Clauses Act, 1871." For this the companies suggest the substitution of the following words:—"The candle-power set against each group of lamps in such schedule shall be the minimum power as directly measured by the Council's photometrical apparatus placed at about 3 ft. above ground level, the said apparatus being such as shall be mutually approved by the parties hereto. The tests shall be taken in such a manner as to ensure that glazing bars shall not interfere with the results obtained. The candle-power of each lamp tested shall be arrived at by taking the average of two readings in any position with regard to the light under test, one reading at an angle of 20° and a second reading at an angle of 50° to the horizontal, and in the event of the average candle-power of any three adjacent lamps falling more than 20 per cent. below such minimum, the contractor shall, on receipt of a written communication from the borough surveyor, carry out such work as may be necessary, so that the minimum power as specified is registered, and in the event of the average of the said lamps complained of failing to reach the standard of illumination at a second reading (to be taken at the expiration of 48 hours from the first reading), the contractor shall, unless he can prove to the satisfaction of the borough surveyor that the deficiency occurred through accident or other unavoidable cause, be liable to a penalty not exceeding 2s. in respect of each lamp tested and found to be deficient, and the Council shall be empowered to rectify the defect by its own tradesmen and charge the cost of the same to the contractor, if the contractor fails to do so. The contractor shall be at liberty to be present at any photometrical testing by the Council's officers, and to check the readings when taken. The term "candle-power" referred to in this specification shall have the same meaning as that in the Gas Works Clauses Act, 1871. Complaints of defective lamps shall be sent by the Council to the contractor by messengers, and the receipt of same shall be acknowledged by the contractor. In the event of any question or dispute arising between the Council and the contractor with regard to any of the provisions of this Clause, the same shall be referred to an arbitrator to be agreed upon by the parties (or failing agreement to the president for the time being of the Institution of Civil Engineers) whose decision shall be final and binding." The Committee concur in the opinion of the Works and General Purposes Committee that the proposed new clause is quite unacceptable, as not only does it allow of a normal reduction of no less than 20 per cent. in the candle-power, but the penalty for exceeding this limit would be so trifling and difficult of enforcement as to be practically useless. The Committee are unable to recommend any other than a general scheme for the whole borough, and they, therefore, see no alternative but to accept the condition on which the companies are willing to be bound by Clause 28 as originally drawn—*i.e.*, by making an extra payment of 10 per cent. on the contract price, which will therefore be £7,645 instead of £6,950. The amount provided for in the annual estimate was £7,400. In conclusion, the Committee recommended "That the joint tender of the Gas Light and Coke Co. and the Metropolitan Electric Supply Co., Ltd., dated April 11th, 1911, for lighting the streets of the borough for 10 years for the sum of £7,645 per annum, subject to the deletion of Clause 35 in the specification, and the amendment of the schedule of lighting as proposed by them, be accepted."

The Finance Committee presented a report stating that in connection with the proposals contained in the foregoing report they think it necessary to call the attention of the Council to a few points. It is estimated that the amount to be spent in the ten years is £11,000, but as about £2,000 of this represents underground work which will be the property of the companies, there remains £9,000 for the above-ground property, viz.: columns, lamps, lanterns, &c., which will belong to the Council. As this amount is being paid over a period of ten years, it is clear that the Council are paying more than they would have to pay were they purchasing outright, that is to say, they are paying interest on the unpaid portion. The District Auditor, in his report for the year ended March 31st last, deals with an analogous contract, and considers this system the equivalent to taking up a loan, and that as such, it requires the sanction of the L.C.C. The Committee are of opinion, therefore, that the sanction of the L.C.C. should be first obtained to the form of contract, or that negotiations be entered into with the companies with a view to immediate purchase of the assets represented by the sum of £9,000. They add that were a contract entered into from which this capital sum as a factor was eliminated, it was clear that the contract need not be for more than a few years, thus rendering it unnecessary to bind the Council for so long as ten years.

The report of the Finance Committee was considered by the Council first, and it was agreed to obtain the consent of the L.C.C.

The Mayor moved the adoption of the special report of the Committee of the whole Council on street lighting, with the addition of the resolution already agreed upon under the Finance Committee's report.

Alderman Charles E. Green said, in spite of the fact that the report before them was agreed to almost unanimously in Committee of the whole Council, he still held that the expenditure contemplated was unnecessary. When it was discovered that they could get 50 per cent. more light by electricity for the same money as the gas company wanted, the Council were informed that the electric people's quotation was not a tender at all. He could not understand why they should have been allowed to waste six months in getting something that was not required, and meant nothing when they had it. Mr. Green went on to say that he could not understand further why in January of this year 260,000 C.P. was considered sufficient lighting for the borough, while in November 405,000 C.P. was recommended, and now this was increased to 424,140 C.P. He thought the Works Committee should be asked to get a tender that should not exceed £6,000 a year, which he believed could be easily done by either the gas or the electric people.

Alderman Max Clarke said the Works Committee had never asked for a tender for more than 405,000 C.P.; the companies themselves suggested an increase of light in certain places such as Holborn, New Oxford Street, and Shaftesbury Avenue, so as to make the lighting more compatible with the high standard in neighbouring boroughs. The Works Committee were not at liberty to make a modification in that tender; they felt bound to either accept or reject it as it stood.

Councillor Jewell said they ought to have fallen back on the first tender received from the electric people. The present candle-power proposed was too much, and the price was too much.

Alderman Nolan Glave said he did not agree that the side streets were sufficiently lighted, and, in fact, the light of the borough

depended largely on the theatres, public houses and shops. When these were closed the light was very bad indeed. The proposed scheme would give them a capital opportunity of judging whether electricity or gas was the better light.

Councillor Wilson said it was no good treating the matter as an experiment between gas and electricity, when it was proposed to bind the Council for 10 years. He urged that the Council should try to get the contract made determinable at the end of five years if the experiment was not successful.

Several members expressed the opinion that they had not had time properly to consider the report, and it was pointed out that no amendment was before the meeting.

Alderman Green then formally moved, and Councillor Jewell seconded, that the report, together with the Finance Committee's resolution, be referred to the Works Committee. The amendment was adopted without further discussion by 25 votes to 5.

BUSINESS NOTES.

Competition in the Transvaal.—In a recent report, American Consul Gunsaulus, Johannesburg, says that supplies for Transvaal mines and works are practically all purchased through local dealers or representatives acting for the foreign manufacturer. "Thus, American manufacturers or jobbers interested in securing a share of this business must of necessity have their representatives or agents on the ground to submit bids when tenders are asked for, or in other cases to personally solicit orders. Nearly all of the leading mine-machinery concerns of the world, including several American firms, are thus represented, while numerous other manufacturers of mining supplies of various kinds have resident agents. Competition is keen in the mining trade, especially in the matter of electrical machinery and supplies. German manufacturers have for years been making a strong bid for this particular line, and it is common knowledge that their success in securing orders is due almost entirely to the fact that the prices submitted by them are as a rule lower than those of American or other foreign concerns. Prices here, as elsewhere, are powerful factors in securing orders . . . . the business is almost certain to go to the concern quoting lowest prices."

Belgium.—The British Vice-Consul at Brussels (Mr. T. E. Jeffes) reports that a civil engineer at that place wishes to get into touch with British manufacturers desirous of supplying goods to the Belgian Government Departments, and in particular goods for the telegraph and telephone services. The name and address may be obtained at the Commercial Intelligence Branch of the Board of Trade, London, E.C.—*Board of Trade Journal.*

South Africa.—THE ALBION MOTOR-CAR CO., LTD., of Scotstoun, Glasgow, have lately completed a 32-H.P. petrol-motor tower wagon for use in connection with the electric tramways in Johannesburg.

Glover's Almanac.—We have received from MESSRS. W. T. GLOVER & CO., LTD., Trafford Park, a copy of their tenth almanac, for the 12 months commencing July 1st. The stand now takes the shape of a drum of Glover's cable. The daily leaflets, as usual, contain useful technical notes, humorous sketches, &c., which must have involved great labour in preparation, and will, no doubt, be appreciated by the engineering reader.

"Twin-Grip" Lampholders.—Referring to the disaster at the Edinburgh Empire Theatre, which is now definitely stated to have been due to an electric lantern, MESSRS. "TWIN-GRIPS," LTD., of 104, Bishopsgate, E.C., write drawing attention to the value of the Twin-Grip lampholder for preventing short-circuits at the holder, as compared with the ordinary single-grip type. They state that they have purposely put the holder on the market at a price which produces only a very small profit, so as to enable the contractor to use it on all his jobs, and that, when consumers are made acquainted with its advantages, they willingly pay the extra cost.

Arc Lamp Patent.—We are informed by the REGINA ELEKTRIZITATS GESELLSCHAFT M.B.H., of Cologne, that they have succeeded in their action for the cancellation of the patent, No. 185,758, owned by the German Beck Lamp Co., on the strength of which the latter company took action against them two years ago. This patent related to the shortening of the negative carbon in lamps with carbons side by side.

Rubber Exhibition.—THE NORTH BRITISH RUBBER CO., LTD., Edinburgh, have taken a large stand at the forthcoming International India-Rubber Exhibition to be held at the Agricultural Hall from June 24th to July 14th, and will there have a most comprehensive exhibit of their productions. Their stand will be No. 27, in the centre of the Main Hall. A cinematograph show, illustrating the various departments at Castle Mills and the numerous processes of manufacture, will be given in a special room.

Dissolution.—PHŒNIX ELECTRIC HEATING CO.—Messrs. S. A. Sillem, F. A. Donnison and W. Sillem have dissolved partnership. Debts, &c., will be attended to by Mr. S. D. Cox, who will continue the business under the same name at the same address (17, Morwell Street, Tottenham Court Road, W.C.).

Book Notices.—"*Transactions* of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXVII, Part 6. June, 1911. London: Andrew Reid & Co., Ltd.

"*Journal* of the Franklin Institute." Vol. CLXXI, No. 6. June, 1911. Philadelphia: The Institute. Price 50 cents.

"Electricity in Locomotion." By A. G. Whyte. 1911. Cambridge: University Press. Price 1s. net.

"*Journal* of the Western Society of Engineers." Vol. XVI, No. 5. May, 1911. Chicago: The Society. Price 50 cents.

"Handbuch der Elektrotechnischen Literatur." 1900-1910. Leipzig: Schulze & Co.

"How to Manage a Suction-Gas Producer." By W. A. Tookey. 1911. London: Percival Marshall & Co. Price 1s. net.

"*Transactions* of the Illuminating Engineering Society." Vol. VI, No. 5. May, 1911. Easton, P.: The Society. Price 75 cents.

Messrs. J. & A. Churchill have in preparation a new annual to be called "Who's Who in Science," edited by Mr. H. H. Stephenson. Schedules are now being addressed to the scientists whose names may appear.

Catalogues and Lists.—*The Cinematograph Theatre* is a booklet issued by the BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., Trafford Park, Manchester, in which the use of electricity for the lantern and for lighting the theatre is discussed, and the advantages of motor-generators for the supply of the lantern are explained. Where a public supply of electricity is not available, Westinghouse gas engines or petrol-electric sets are recommended. The lighting and ventilation of the theatre, with arc and metal-filament lamps and electric fans, are also dealt with. A reprint, we understand, is already in the press, and will contain in addition the full set of regulations governing the use of electricity in cinematograph theatres. Copies will be sent to our readers on application.

TELEPHON UND TELEGRAPHENWERKE STOCKER UND CO., Leipzig.—Leaflets relating to indicators, bells, domestic and other telephones, primary cells, terminals, &c.

THE GENERAL ACCESSORIES CO., LTD., 148-150, Curtain Road, London, E.C.—Price leaflet of letters, crowns and lampholders, for Coronation electrical illuminations.

THE QUEEN'S ENGINEERING CO., 60, Queen's Road, Battersea, S.W.—Small pamphlet containing a description of their "Halso" semi-enclosed direct-current ventilating fans, also belt-driven fans, which are made at the firm's works in London, and are now being introduced to the market for the first time. Prices are stated.

Trade Announcements.—MESSRS. JAEGER BROS. have just removed their electrical accessories offices and showrooms to 18, Christopher Street, Finsbury Square, E.C.

MR. DOUGLAS MANN, electrician, has opened new business premises at 20, Torwood Street, Torquay.

MR. BALFOUR ROBERTSON, at present manager at the Edinburgh branch of Lowdon Bros. & Co., severs his connection with this firm at the end of the month, and is starting in business on his own account at 50, Frederick Street, Edinburgh, where he will continue in the business of electrical engineer and contractor, and will be glad to receive catalogues from the trade.

Bankruptcy Proceedings.—E. L. OPPERMANN, late of 74, Wool Exchange, E.C.—A sitting of the London Bankruptcy Court was held last week, before Mr. Registrar Brougham, for this public examination. The liabilities were returned at £2,425, as against assets £12. In reply to Mr. G. W. Chapman, Official Receiver, bankrupt stated that he was engaged abroad as an engineer prior to 1905. He then returned to England and became engaged in a syndicate in connection with an electrical storage battery which he sold in July, 1905, to the "X" Electric Accumulator Co., Ltd., for £3,158 in cash, and £26,500 in shares, a large number of which were allotted to other persons. He acted as managing director of the company at a salary of £500 a year until it failed in 1908. The "X" Syndicate, Ltd., was next formed to take over the business, and he acted as its managing director at the same salary until it went into compulsory liquidation in October, 1909. Since then he had been engaged in an unsuccessful attempt to promote a company to take over some rubber concessions in Sumatra, on which he held an option. For that purpose he had a seat in an office at 74, Wool Exchange; the option expired before he could exercise it, and he lost about £600 on the scheme. He had also lost about £100 in connection with a timber concession in Persia, £175 in experiments on a new change-speed gear for motor-omnibuses, and £350 on a poultry farm at Holmwood.—The examination was concluded.

C. E. MARRIAN & H. E. WELLS, merchants, 23, Ropemaker Street, E.C., trading as Marrian, Wells & Co.—An application for an order of discharge was made last week to Mr. Registrar Brougham at the London Bankruptcy Court, on behalf of the above. Mr. G. W. Chapman, Official Receiver, reported that the applicants closed down their business in August, 1908, giving their creditors, as security for their claims, shares in the British Photo Lexigraph Co., Ltd., which they had formed for the purpose of taking over an option to work an electrical advertising appliance. Owing to the refusal of the L.C.C. to grant a licence to work the appliance in London, the company did not start business, and went into liquidation last February. After hearing Mr. Kingham in support of the application, his Honour suspended the order of discharge for three years.

EMANUEL RISTORI, civil engineer, 54, Parliament Street, Westminster.—A receiving order was made on June 12th, on a creditor's petition filed May 9th. First meeting June 30th; public examination August 15th. We recorded the death of Mr. Ristori in our issue of May 26th.

Church (Lancs.).—A sub-committee of the U.D.C. has been appointed to consider the question of purchasing a syren alarm to be worked by electricity.

LIGHTING and POWER NOTES.

Barking.—The Ratepayers' Association has decided to employ counsel to oppose the application of the U.D.C. for a loan of £11,400 for electricity purposes.

Barnstaple.—A statement of accounts of the Electricity Department for the year ended March 31st, 1911, shows that the expenditure on the revenue account for the year has been £3,258, against £3,000 last year, and the receipts have been £4,699, against £4,411, the gross profit for the year having increased from £1,411 to £1,441, leaving a balance to net revenue of £346. The sum of £200 is provided as the amount transferred from general district rate on account of deficiency to March 31st, 1911.

Bexhill.—The financial report of the municipal electric light undertaking for the year ended March 31st last, shows a net profit of £561, compared with £859 the previous year, and £756 in 1909. The gross income was £10,907, and the expenditure £5,834, leaving a gross profit of £5,073, which is equal to 7 per cent. on the capital of the undertaking. The net profit when added to the last year's carry forward amounts to £1,257. Of this sum £298 has been placed to the depreciation fund, £130 to superseded works, and £239 to the payment of capital assets, leaving a balance of £590 to be carried forward to the next year.

Bispham.—The U.D.C. has formulated a scheme for electrical lighting, and a L.G.B. inquiry was conducted on June 14th by Mr. T. C. Ekin, M.Inst.C.E., into the Council's application for sanction to borrow £9,180 for the purposes of the undertaking. In 1908 the Council obtained a provisional order for the supply of electricity, but the B. of T. suggested that the Council should, if possible, take a supply from the Blackpool and Fleetwood Tramways Co., who opposed the present application. On behalf of the Council, it was stated that negotiations were entered into between the company and the Council, but they came to nothing. Seeing the B. of T.'s suggestion could not be carried out, the Council had to consider a scheme of its own for lighting, and had no alternative but to proceed, otherwise the provisional order would be revoked. The provisional contract for a site for the generating station in Red Bank Road has been entered into. The first estimated receipts for private lighting are £589 15s.; for public lighting, £250; and for motive power, £295. Several other parties, in addition to the Tramways Co., opposed the application.

Continental Notes.—GERMANY.—A central electricity generating station of 6,000 H.P. capacity is about to be established by the Landkraft Gesellschaft. of Leipzig, in connection with the collieries of the Leipziger Braunkohlenwerke Ges. at Kulkurtz, Saxony. The current will be generated at 2,000 volts and transmitted at 30,000 volts. It is expected that the new station will be able to supply current for lighting and power purposes to no less than 19 towns and 604 villages in the district.

Crewe.—A report presented to the Corporation by Mr. H. H. Denton, electrical engineer, covering last year's work in connection with the electricity department, shows that the surplus was £1,268, compared with one of £1,478 in the previous year. This is locally considered satisfactory, and with the projected extensions to the new Postal Sorting Office, the Crewe County Training College and Hostel, and the Webb Orphanage, which are all to be connected to the Corporation service, the outlook is promising.

Canada.—The Ottawa Municipal Light Co. has started measuring the houses in consonance with the new plan of charging for electric light. The intention is to charge 4 cents for each 100 sq. ft. of house area and 3 cents per unit, and this is supposed to bring the cost down to about 6 cents per unit. A big gang of men is now measuring the fronts and sides of the houses to ascertain the area for each floor. The basement is not counted, and the attic is cut in half; summer kitchens, outhouses and verandahs are not counted, and 10 per cent. is deducted for walls. This system is now in use in the City of Toronto, and the following table was prepared by the Toronto Electrical Department. Average floor area of Toronto houses according to the number of rooms taken from over 200 plans presented to the city architect:—

Rooms.	Total area in sq. ft.	Monthly fixed charges, $.
4	650	·26
5	875	·35
6	1,100	·44
7	1,350	·54
8	1,650	·66
9	1,850	·74
10	2,200	·88
11	2,950	1·18
12	3,800	1·52

Added to this, the current will cost 3 cents per unit. At present Ottawa is paying 8 cents.

Darton.—The Yorkshire Electric Power Co. has placed an electric supply scheme for both private and public lighting before the U.D.C., but the Council has deferred the matter until the company makes an application for an order.

Doncaster.—The L.G.B. has approved of a scheme of main sewerage and sewage disposal for the parish of Owston and Skellow, in the Doncaster R.D.C. There are several miles of main sewers to be constructed with cast-iron pipes which will gravitate to an underground storage tank from which the sewage will be electrically pumped to the disposal works, where it will be treated in open tanks followed by filtration through percolating filters before being discharged into the adjacent watercourse. The engineers for the work are Messrs. D. Balfour & Son, London.

Elland (Yorkshire).—At a meeting of the U.D.C., held on the 14th inst., it was reported that a deputation of the Council had waited upon the members of the Greetland U.D.C. with respect to taking over of its provisional order and supplying it with electricity. The Council, however, decided that it could not entertain the proposal. If, however, the Greetland authority was prepared to take a supply in bulk at its boundary and give an undertaking for a certain supply, to recoup Elland for the outlay and cost, it was prepared to enter into negotiations.

Dudley.—The annual report of the Corporation's electric light undertaking was issued last week. The capital expenditure now stands at £97,310. There has been an increase of 37,400 units in the current sold for lighting, equal to 8¾ per cent., and in power supply an increase of 140,000 units, or 27½ per cent. The amount supplied to the Tramway Co. shows a reduction of 14,298 units. The cost of production has been £7,049, or 0·78d. per unit. The income has been £13,000, making the gross profits £5,959, an increase of £135. The undertaking has been debited with £500, the first instalment of the cost of the arbitration in reference to the price of tramway current, reducing the gross profit to £5,459. The repayment of loans and interest, and bank charges represents £6,665, making a balance against the undertaking of £1,206. It is of interest to note that had the Tramway Co. been supplied with current at the old rates, and had there been no arbitration costs to pay, there would have been a net profit of £302. Although the accounts show a debit balance, it is considered that the progress and saving effected during the year have been satisfactory.

The T.C. has approved of certain recommendations of the Tramway and Lighting Committee, involving an expenditure on extensions of over £8,000.

Ewell.—Schemes for electric lighting have been placed before the P.C. by the U.D.C. and a private company, and the matter is being considered by a Committee.

Finchley.—The annual report of the electricity undertaking shows a total income of £17,809, while the total amount of working expenses was £8,625. After deducting interest and payments to sinking fund there remained a net surplus of £1,588, which is to be carried forward as working capital, as the auditor has insisted that there should be no overdraft.

Guisborough.—The Cleveland and Durham Power Co. has placed before the ratepayers a scheme of electricity supply for the town. A representative of the company states that the U.D.C. would be able to retail energy at 5d. per unit and make a substantial profit. The Ratepayers' Association has taken up the matter.

Hartshead (Yorkshire).—A scheme has been initiated for the provision of public electric lighting for Hartshead. The matter first came before the Halifax R.D.C., and was referred by it to a Committee consisting of Sir George Armytage, chairman of the Council, and Mr. S. Jackson, who represents Hartshead. The Committee went into the matter and reported in favour of electric lighting direct from the Yorkshire Electric Supply Co. The feeling in the village of Hartshead is strongly in favour of the scheme.

Haslingden.—The B. of G. has decided that application be made to the L.G.B. for sanction to borrow £1,460 for the purpose of installing electric light in the workhouse buildings.

Hastings.—The T.C. on June 16th decided to apply to the L.G.B. for a loan of £581 for extensions of mains. Including public lighting, the estimated revenue by the extensions is £107 per annum.

King's Lynn.—At the monthly meeting of the T.C. the Chairman of the Electricity Committee presented the balance-sheet of his department for the year ended March 31st last, showing a net profit of £1,034 as compared with £838 in the previous year. The gross profit was £4,089, equal to 8 per cent. on the capital expenditure. It had been agreed, out of this year's profit, to wipe off £280 from the capital expended in excess of sanction, and also to hand over for the relief of the rates of the borough £300, equal to nearly a penny in the pound.

Kirkburton.—The U.D.C. has asked the Yorkshire Electrical Power Co. to state the terms upon which they are prepared to supply energy for public lighting.

Menai Bridge.—The U.D.C. on June 13th sealed an agreement with Mr. W. E. Parry for the lighting of the town by electricity.

Manchester.—The L.G.B. has held its inquiry into the application of the Corporation for sanction to borrow £12,186 for electric lighting, and to divert £50,000 already borrowed for mains and services, to other purposes of electric lighting. Speaking of

the former, the town clerk said this was a balance, unborrowed and sanctioned, of a sum of £130,500, while the £50,000 was part of the sum of £75,000, authorised on June 12th, 1901, for street lighting. They had not considered it necessary to spend that £75,000, and they wished to divert £50,000 for the provision of mains and services.

Nantwich.—The R.D.C. has consented to Crewe T.C. laying mains in the rural area for the purpose of supplying current to the Cheshire County Training College and hostel, and to the new postal sorting office.

Rushden and Higham.—The Higham Ferrers T.C. has decided to offer no opposition to the revocation of the prov. order for E.L. held by a private company, but reserves full freedom of action should a fresh order be applied for by the present promoters. The existing order was obtained five years ago.

South Africa.—RHODESIA.—H.M. Trade Commissioner for South Africa reports the publication of an Ordinance empowering the Salisbury municipality to raise a loan of £120,000 for the purpose of providing the town with a supply of water and electricity, and of other municipal improvements.

Stafford.—The annual report of the working of the Corporation's electricity undertaking states that the revenue from all sources reached £4,924, while the expenditure was £2,190; the gross profit being £2,734, as compared with £2,478. The charges against net revenue account amounted to £2,126, leaving a net profit of £607, which, added to £144 brought forward from last year, gives a total of £752. From this the Committee proposes to transfer £600 to the depreciation account, and, after deducting the bonus, to carry the balance forward. In pursuance of the arrangement as to profit-sharing by the employés, a bonus of 10·4 per cent. goes to the officials and workmen of the department.

Stockton-on-Tees.—A L.G.B. inquiry was held on June 15th into the application of the T.C. for a loan of £6,750 for additional electricity plant. There was no opposition.

Stoke-on-Trent.—A L.G.B. inquiry was held on the 14th inst. into an application for sanction to borrow £60,000 for the provision of a new central power station to be erected near the existing works at Hanley. The application was opposed by the North-Western Electricity and Power Gas Co., by the North Staffordshire Railway, and by several ratepayers. Mr. G. Millward, counsel for the North-Western Electricity and Power Co., said the Corporation's scheme did not make for economy or efficiency, and when the rates were so high they ought not to go in for what he considered a patching-up scheme. What was proposed was combination, and it was admitted that the Corporation had not taken the steps necessary for combination. There were already different schemes in the borough, and this new scheme would add to the confusion. Mr. Marshall addressed the Inspector on behalf of the railway company, and contended that at the present time new expenditure ought not to be incurred on account of the high rates; he urged that the company's scheme was the best way of providing a further supply of electricity. Alderman Green, who addressed the Inspector, said that in opposing the Corporation scheme and in asking that the company's scheme should be considered, he was representing a large number of ratepayers—large as well as small. Mr. Drury, counsel for the Corporation, replying, suggested that the opposition of the power company was simply that of a rival trader. It was impossible to face the coming winter without an extended supply, and the new Council had decided that instead of an extension of the existing four stations in Hanley, Burslem, Stoke and Longton, the best course to adopt was to build a central station in Hanley. Mr. Yeaman, the borough electrical engineer, said he thought the offer of the company would be unsuitable and burdensome. Each of the sub-stations would bear its share of the cost of the central station. Mr. Snell, consulting engineer, expressed the opinion that the Corporation by its new scheme could make a profit of £8,000 a year.

Sunderland.—At a meeting of the T.C., on the 14th inst., the annual report of the Electricity Committee was submitted. It showed that the total output had been 10,208,493 units for the year ended March 31st, as against 7,848,815 in the previous year. Of the units sold 6,282,119 had been for power, 1,206,431 for ordinary lighting, and 1,702,872 for traction. The total income had been £55,485, and after meeting ordinary expenditure, £31,488 was carried to the net revenue account. After meeting interest and sinking fund there was a net profit of £1,189. The deficiency remaining at March 31st, 1911, after providing £2,016 for additions to plant and £1,126 taken out of the rates, was £1,014. Ald. Bruce, in moving the adoption of the Committee's report generally (which included the annual report), complimented Mr. Blackman (the electrical engineer) on the successful year he had had. Their engineer, Ald. Bruce pointed out, had reduced the coal consumption per unit sold from 4·35 lb., as in March, 1910, to 3·7 lb. in March, 1911, and he was getting now into the neighbourhood of the lowest coal consumption per unit sold in the whole country. Mr. Robert Hudson seconded the adoption of the report, which was carried, the further consideration of the annual report being adjourned.

Taunton.—The electricity undertaking for the past year shows a gross profit of £4,059, which, after paying interest on loans, redemption of loans, and other smaller amounts, leaves a balance to be carried forward of £105. Mr. G. Spiller, moving the adoption of the report, said that although they had received £72 less for public lighting, they had taken £332 more than in the previous year for energy. If the undertaking had been worked as a company, the profit would enable them to pay 4½ per cent. interest on a capital of £70,000, and place £800 to reserve fund.

The T.C. has applied to the L.G.B. for a loan of £2,500 for electricity purposes.

Venezuela.—La Compania Generadore de Fuerza y Luz Electrica is the name of a new company which has lately been formed at La Guayra, with a capital of £100,000, to put down a plant to utilise the water power of the Mamo Falls in the generation of electrical energy for lighting and power purposes in the district.

Wombwell.—The U.D.C. has received notice of the intention of the Yorks. Electrical Distribution Co., Ltd., to apply for a prov. order for electric lighting, but the U.D.C. proposes to apply for its own order, to include the district of Darfield.

Weaverham.—An E.L. scheme for the parish, and also for Acton and Acton Bridge, has been prepared by a private company formed by local gentlemen with a capital of £2,500. The scheme will be carried out by Mr. A. J. Leigh, of Northwich, and the supply will be by means of overhead cables. The R.D.C. has given consent to the scheme.

Wednesbury.—The T.C. has decided to proceed with a scheme for extending the electricity works and plant at an estimated cost of £2,250. This step has, to a certain extent, been rendered necessary owing to the increased demand for electricity. At the meeting of the Council, Alderman Griffiths, in emphasising the urgency of the case, said there were times when difficulty was experienced in generating sufficient electricity to meet the normal demand. The annual report showed that there was a net profit of £583 on the year's working. The customers had increased by 92, and in the sale of energy the number of units had risen from 433,267 to 634,356.

Worcester.—At a meeting of the City Council last week the accounts of the Electricity Department, showing a small deficit, were submitted for adoption. Mr. Fairbairn, in criticising the department, said if they found it impossible to show a profit fairly, they should write off a part of the capital. Alderman Millington was for selling the undertaking, and he believed that at the present time they could do that with advantage. He moved that the Committee confer with him as to negotiations with a probable purchaser, and report to the Council as to the probable financial result. The chairman of the Committee asked Alderman Millington for the name of the probable purchaser, but Alderman Millington declined to reveal it, though he said it was perfectly genuine. Mr. Fairbairn said he hoped the Council would reject Alderman Millington's proposal. Whatever any company could do with the undertaking the Council could do. The motion was lost, and the accounts were approved.

Whitehaven.—At the T.C. meeting on June 14th, it was reported that the expenditure under the last electric lighting loan had exceeded the borrowing powers by £450. Ald. Musgrave deprecated criticism of the electric lighting expenditure at the present stage, and said the electrical engineer was confident that when the new plant got into proper swing the results would be very gratifying.

TRAMWAY and RAILWAY NOTES.

Argentina.—The first section which has been electrified of the Nacional Tramway Co.'s undertaking in La Plata, has been opened to public service.

The general manager of the Anglo-Argentine Tramways Co. states that work on the construction of the Buenos Ayres tube from the Once to Plaza Mayo will commence on September 15th. All the necessary material has been ordered.

Ashton-under-Lyne.—The tramway men have joined the Corporation workmen; their demand includes better wages and conditions of employment, shorter hours, extension of holidays, and the abolition of the odd week on the Manchester section. The T.C. has consented to grant an interview to the men and their secretary, Councillor Jones, of Manchester.

Continental Notes.—SERVIA.—It is proposed to construct a system of electric tramways in the town of Nisch.

SWEDEN.—It is proposed to adopt electric traction on the railway between Stockholm and Saltsjobaden, a distance of about 9½ miles.

Canada.—VANCOUVER.—A new system of fire-alarm signalling is being installed at the most important street corners in the city of Vancouver. It will be impossible for street cars to keep in motion while fire apparatus are dashing along those streets. At convenient points will be constructed an arm 20 ft. in length, with red lights and a warning sign, which automatically drops on an alarm of fire being given, should the apparatus desire to proceed along either street. A loud-sounding gong will also be among the warning signs of approach. The arms will swing across the car tracks.

Leeds—Bradford.—The railless trolley system from Laisterdyke to Dudley Hill was to be opened on Tuesday, the 20th inst., simultaneously with the starting of the Leeds Railless Trolley Cars to Farnley. These are the first railless trolley cars in the country. After the ceremonies the Leeds and Bradford Civic Fathers were to have luncheon together at the Leeds Town Hall.

Perth.—An amusing discussion took place at a Council meeting over a recommendation of the Tramway Committee that a band should be engaged for one month to play at Buckie Braes and Scone, "so as to induce people to travel on the cars." Treasurer Rolls opposed the proposal, stating that the Tramway Committee had no legal right to spend money on bands. It might as well, he remarked amid laughter, have a Punch and Judy show at each terminus of the tramways. The Lord Provost did not seem to realise that there was such a thing as an Act of Parliament which prevented them from spending that money. A member humorously suggested that the services of a piper should be got. Councillor Macpherson said it was a spurious method of making the cars popular. If they offered £10 worth of free drinks at each terminus they would have a rush for the tramways. The matter was remitted to the Band Committee. The Council discussed in Committee the proposal to separate the offices of tramway manager and electrical engineer. The recommendation is that Mr. Lambert should continue as electrical engineer and have charge of the overhead work of the tramway system at his present salary of £350, and that Mr. W. G. Snell, traffic superintendent, be appointed interim tramway manager for a period of three months, his salary to be at the rate of £130 per annum.

The T.C. is purchasing a motor-'bus to act as a feeder for the Corporation tramways.

Scarborough.—The borough engineer estimates that to take up the tramlines and relay the roadway will cost about £6,000. It is reported that a company contemplates taking over the present tramways and running railless cars.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board accounts show that the deficiency on the tramways during the year was £5,938, and the deficiency on the electricity department £5. At a special meeting of the Tramways Board it was decided to issue precepts on the four Corporations of Stalybridge, Hyde, Mossley and Dukinfield for the amount of the deficiency. Alderman Clarke said the deficiency on the tramways was a reduction on last year of £510, and during the last three years they had decreased their losses by £4,442. In the last four years they had reduced the adverse balance in the electricity department from £5,466 to £5, which was very creditable.

Swinton and Pendlebury.—The objections to the original Bill of the South Lancashire Tramway Co. having been met, the U.D.C. has decided to offer no further opposition.

Tarporley.—The Light Railway Commissioners have submitted for the confirmation of the Board of Trade an order reviving the powers granted by the Tarporley Light Railway Order, 1906, and extending the time for the completion of the railway.

Uruguay.—In connection with the Monte Video tramway strike, the workers, after returning to work for one hour, went out again; the next morning a general strike was declared in Monte Video by over 30 societies, and business in the town was practically suspended. Several encounters took place between the authorities and the strikers, although none were fraught with any very serious results. Troops were called out to guard the tramway and electric power stations, &c.

Wrexham.—It is reported that the proprietors of the Wrexham and District Electric Tramways have under consideration the question of extending their service in the borough, and also at the other end of the line from Johnstown to Ruabon.

TELEGRAPH and TELEPHONE NOTES.

State Cables.—At the Imperial Conference last week, the subject of Imperial communication was discussed. Sir Joseph Ward, for New Zealand, moved a resolution that it was desirable to secure reductions in the cable rates of the Empire. Mr. H. Samuel expressed the sympathy of the British Government with the resolution, and said that steps were being taken in several directions to secure lower rates. It was hoped to obtain a reduction of 50 per cent. for deferred messages (not in code) and a reduction in Press rates; it was proposed also to insert a clause in all new landing licences that would give effective control over rates, the cable companies having the right to appeal to the Railway and Canal Commission. The development of wireless telegraphy might also have some effect on cable rates. Sir Wilfrid Laurier (Canada) said the trouble was due to the Atlantic cables. Mr. Fisher suggested that low rates should be charged on the Pacific Cable for news from Australia to Montreal, the messages being sent from there to England by mail, and *vice versa*. Senator Pearce pointed out that the policy of the Governments had been to provide cheap rates even at a loss; the Railway and Canal Commission, however, would fix rates that would yield a profit to the companies, so that the proposed clause would not secure the full benefit desired. The resolution was adopted.

Senator Pearce (Australia) then moved a resolution recommending the nationalisation of the Atlantic cable service so as to cheapen communication with the Dominions by providing an "All-Red" route. It would cost £480,000 for a cable across the Atlantic, and £120,000 for a landline across Canada. Working and maintenance would cost for the former, £21,500, and for the latter, £32,500; while an economy of £22,000 would be effected, and a revenue of £36,000 would be immediately obtained, apart from new business. Sir Joseph Ward supported the proposal as the only satisfactory method of dealing with the question, which was of far greater importance to the Empire than the mere reduction of rates. He suggested that the private companies should be taken over on reasonable terms. Mr. Samuel doubted whether the deficiency in revenue could be made up by increased business, in view of the proposed reduction of rates; the State Atlantic cable would get little traffic in the U.S.A. and Canada, because the landlines there were in private hands associated with the cable companies. It had been estimated that the cable would involve an annual expenditure of over £50,000, with a revenue of £25,000; there would be no gain in efficiency compared with the existing service, and in view of the probability that rates would shortly be reduced, he thought the large capital expenditure and risk of loss would not be justified. He proposed, however, a resolution to the effect that if considerable reductions in trans-Atlantic cable rates were not effected in the near future, the laying of a State-owned cable between England and Canada should be considered by a subsidiary Conference, and, the original resolution having been withdrawn, this was unanimously agreed to.

Sir Joseph Ward moved that it was desirable that a scheme of wireless telegraphy, approved at a conference at Melbourne in December, 1909, be extended throughout the Empire, so as to render the latter in emergency independent of submarine cables. Mr. Samuel acknowledged the desirability of the wireless chain, and agreed that the stations should be State-owned and should be established speedily. The Government proposed that a beginning should be made with a chain of six stations—in England, Cyprus, Aden, Bombay, the Straits Settlements and Western Australia, whence it would be linked to New Zealand. Later, South Africa would be connected. The stations might be erected by a company if favourable terms could be arranged; otherwise the Admiralty could do it, but in any case the system would be worked by the local Governments. It was suggested that England should pay for the first three stations named, India for the one in Bombay, New Zealand and Australia for their own stations, and that the cost of the station at Singapore should be divided. As regarded the Melbourne Conference scheme, he was advised that the cost of crossing the Pacific by a chain of stations would be very heavy, the strategic value small, and the commercial value negligible. He suggested that the working expenses and receipts should be pooled, and the profit or loss equitably divided. Sir Joseph Ward agreed to the substitution of a resolution to the effect that the great importance of wireless telegraphy for social, commercial and defensive purposes rendered it desirable that a chain of British State-owned wireless stations should be established within the Empire, omitting reference to the Melbourne Conference, but he and Mr. Fisher reserved the right to consult their own experts as to details and to carry out their own scheme, putting up stations where they pleased. The substituted resolution was adopted.

The Telephone in Train Dispatching.—Altogether, in Canada and the United States, there are 46,077 miles of railway using the telephone system for train dispatching, &c., of which the Canadian Pacific Railway is the largest user, with 3,955 miles of the system in use. The telephone, however, costs seven or eight times more to install than the telegraph. The extra expense is considered a good investment when the greater efficiency of the new service is understood.

Wireless Telegraphy.—The large station at Norddeich is now undertaking, by way of experiment, the transmission of private wireless telegrams to ships which are unable to establish connection with Norddeich, in consequence of their being at too great a distance, and their wireless stations having an insufficient range.

A new Government wireless station has recently been opened at Heacham.

CONTRACTS OPEN and CLOSED.

OPEN.

Barnsley.—July 4th. Extensions to the electricity works, for the T.C. J. H. Taylor, borough surveyor, Manor House Offices.

Birmingham.—June 26th. General stores for the Corporation Electric Supply Department for a year. Mr. Chattock, city electrical engineer.

(*Continued on page* 1007.)

THE TILLING PETROL-ELECTRIC 'BUS.

IN a short note in our issue of the 9th inst. we referred to the appearance of a second petrol-electric 'bus amongst Messrs. Thos. Tilling's fleet of vehicles.

The original 'bus, constructed by Messrs. J. & E. Hall, of Dartford, and known as the "S.B.S." type, was described and illustrated in our issue of January 17th, 1908.

The design included an engine and generator with an independent motor and worm drive to each rear road wheel, an arrangement which, while it has proved satisfactory in working, called for greater weight than was desirable.

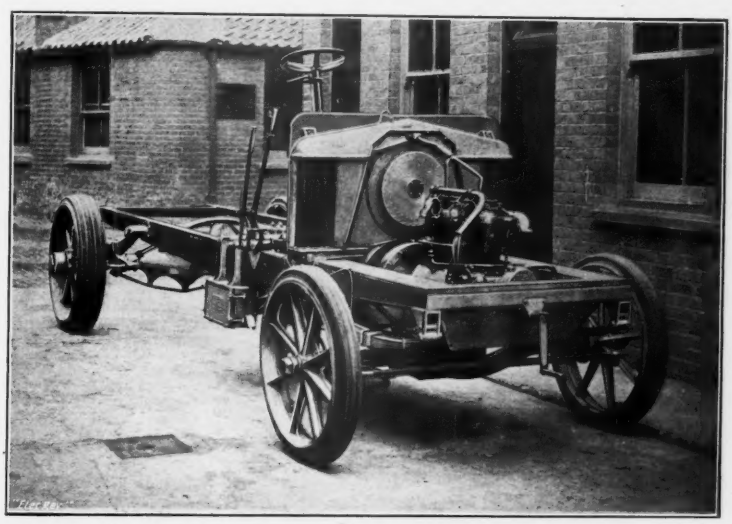
As a matter of fact, the first S.B.S. type petrol-electric 'bus has now run about 120,000 miles in regular service, and has, we understand, shown a saving of approximately 1½d. per mile—all costs included—as compared with the petrol vehicles in Messrs. Tilling's service.

This result was foreshadowed in a discussion which took place at a meeting of the Society of Road Traction Engineers about two and a half years ago (see ELECTRICAL REVIEW, January 29th, 1909), when Mr. P. Frost Smith and Mr. W. A. Stevens, who have been jointly responsible for the design of both the original and the new vehicles, gave actual comparative data as to the working of Messrs. Tilling's 'buses.

The new vehicle is the direct outcome of the experience gained with the earlier one, and as mentioned in our issue of the 9th, it proved unmistakably its easy riding capabilities during a trial run from the new R.A.C. building in Pall Mall to Bromley and back. With the exception of the electrical plant, it has been constructed throughout by Messrs. Tilling at their Peckham shops.

The chassis, which carries a 34-seated 'bus body, has a wheel base of 13 ft. 6 in. and an overall width of 6 ft. 10 in.; it weighs complete 2 tons 7 cwt., as compared with about 3 tons 3 cwt. for the earlier 'bus chassis. The total weight has also been greatly reduced, the 1911 vehicle weighing complete approximately 3½ tons, as compared with 4 tons 13 cwt. in the original "S.B.S." 'bus.

EXTERIOR OF THE LATEST TILLING PETROL-ELECTRIC 'BUS.



TILLING CHASSIS, SHOWING ENGINE, RADIATOR, &C.

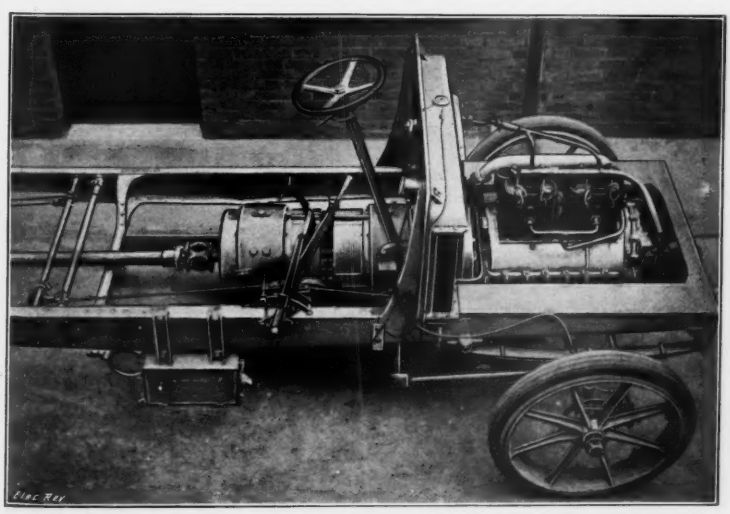
The new vehicle carries a four-cylinder engine, with cylinders 105 mm. × 125 mm. stroke, fitted with H.T. ignition and pump water-circulation, the magneto being entirely enclosed.

Engine, fly-wheel, carburetter, and magneto, weigh approximately 525 lb.; we believe the older vehicle had a four cyl. 110 mm. × 140 mm. engine rated at 30 H.P. or more. The dynamo drive is taken off the fly-wheel through an ingenious flat spring coupling which allows for inaccuracies in alignment of the crankshaft and armature shaft, and which we illustrate on the next page.

This machine supplies energy to a series-wound motor coupled through a universal joint to the propeller shaft which drives the back axle through a worm and worm wheel with differential, the worm running over the worm wheel.

An electrical controller is mounted on the side of the vehicle; it consists of a reversing switch and a shunt resistance for the generator fields, the former being operated by a side lever, and the latter by a small horizontal lever carried on the steering wheel column.

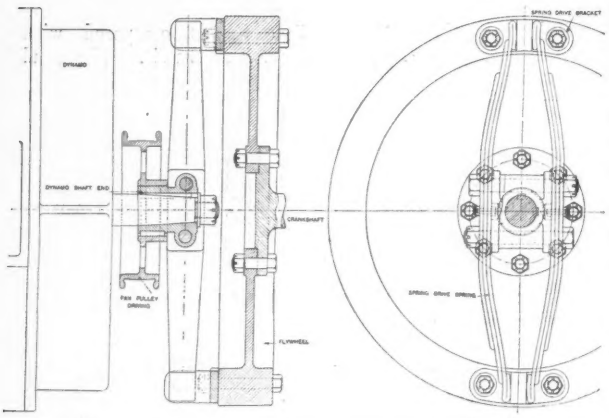
Messrs. W. A. Stevens, Ltd., of Maidstone, were responsible for the electrical equipment, which was constructed under their patents.



TILLING CHASSIS, SHOWING ARRANGEMENT OF ENGINE, DYNAMO, MOTOR AND CONTROLLER.

F

The generator, which is capable of an output of from 1 to 25 KW. at a speed varying from 350 to 1,400 R.P.M. at a voltage varying from 0 to 400, has been carefully designed



Spring Coupling between Engine and Dynamo.

with a falling characteristic, so that any increase in the demand for current when the engine is fully loaded is accompanied by a corresponding reduction of voltage. The output in KW. at any speed is proportional to the power exerted by the engine, but the voltage and current may vary over a large range, according to the gradient, speed or degree of acceleration required. The current required by the series-wound motor is nearly proportional to the torque on the propeller shaft, and the speed of the motor is to a less degree proportional to the voltage of supply. It follows that when the vehicle is running on the level road, the demand for current will be small, but on gradients it will considerably increase, with a corresponding decrease in voltage, resulting in a lower speed with increased torque, this change taking place automatically.

On level roads and ordinary gradients, the whole of the control is effected by the gas-throttle pedal operated by the right foot of the driver.

On stiff gradients the shunt resistance has to be employed to allow of increased engine speed. The controller has three positions, forward, neutral and reverse, the whole of the speed regulation being effected with the one position of controller. As the generator ceases to excite at an engine speed of 300 R.P.M., it is not necessary to break the circuit between dynamo and motor on stopping in traffic, as by the release of the throttle pedal and the consequent slowing down of the engine, no power is transmitted to the propeller shaft.

The field windings of the machines are so arranged that it is impossible for the driver to "jump" the 'bus, and as the main circuit is never broken during driving, no sparking at contacts can occur.

The machines, which are of the semi-enclosed type, are ventilated by a disk fan on the generator shaft end, next to the motor. The armatures of the generator and motor are of the same size, having heavy nickel steel shafts running in ball bearings carried in strongly ribbed aluminium end covers.

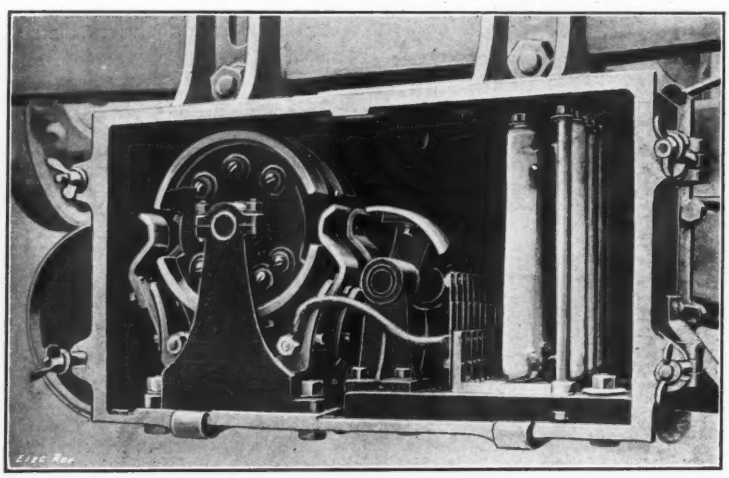
The overall commercial efficiency of the electrical plant running in normal omnibus service is 79 per cent, being 90 per cent. on the motor and 88 per cent. on the generator.

The insulation resistances of both generator and motor, tested at a pressure of 1,000 volts continuous, were considerably over 50 megohms each.

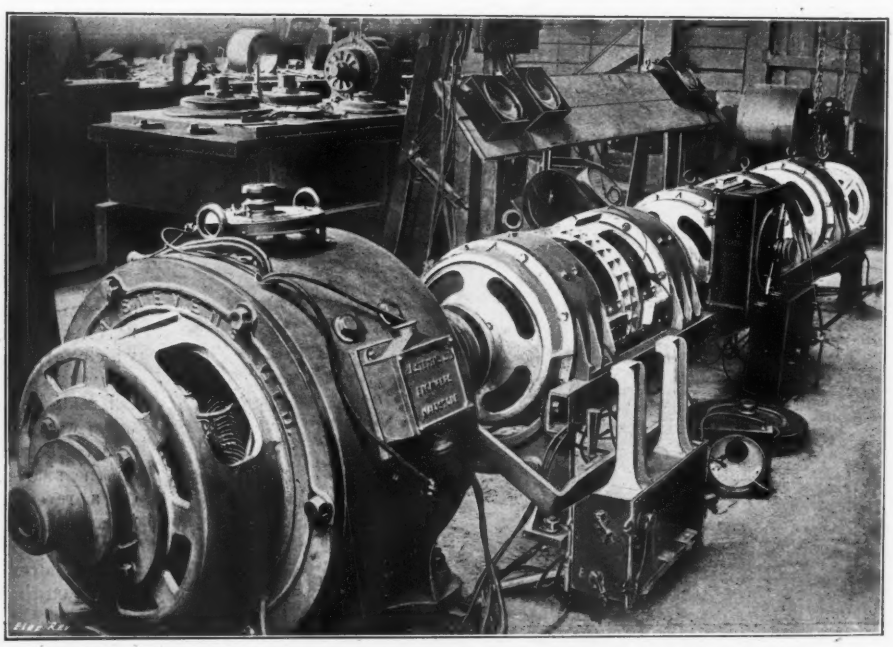
For the system it is claimed that the control of the vehicle is the simplest yet employed; control on level roads and slight gradients is entirely effected by the use of the throttle pedal, no circuits being broken in driving.

Great economy is secured in petrol consumption owing to the engine speed averaging considerably less than that of the propeller shaft, and owing to the vehicle's great powers of free wheeling the engine is running with its throttle nearly closed a great part of the time.

The elastic start up and drive are also valuable features



Controller Box with Cover Removed.



Omnibus Dynamos and Motors under Test in Messrs. Stevens' Works at Maidstone.

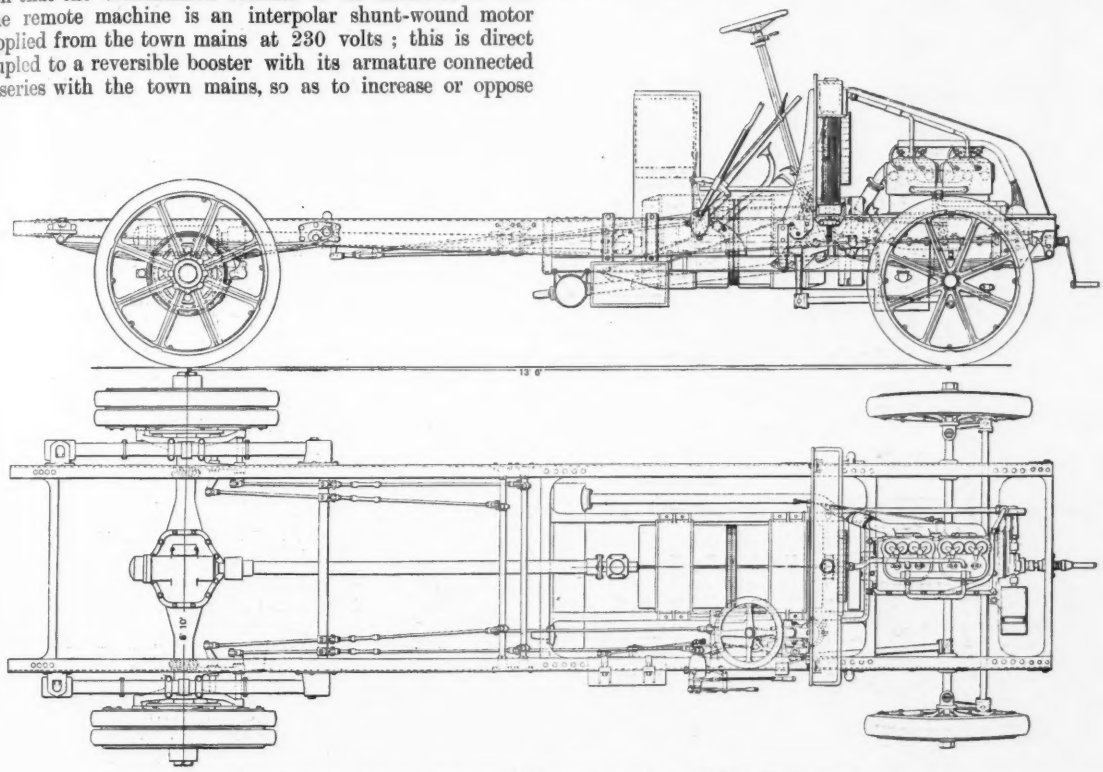
which can scarcely fail to lead to saving in maintenance of both engine and vehicle as a whole.

One of our views (page 1004) shows the test-bed employed by Messrs. Stevens for testing characteristic, torque and efficiency of omnibus generators and motors. It will be seen that the combination consists of six machines in line. The remote machine is an interpolar shunt-wound motor supplied from the town mains at 230 volts ; this is direct coupled to a reversible booster with its armature connected in series with the town mains, so as to increase or oppose the current from the same to the third machine—a series-wound motor, representing the petrol engine of the omnibus. By means of a reversible potentiometer rheostat in the fields of the booster, the voltage across the series-wound motor can be varied from zero to 460, enabling the speed of the motor to be varied from zero to 2,000 R.P.M., with as much acceleration as is possible with a petrol engine.

The series-wound motor is direct coupled to the dynamo of the 'bus, which supplies current to the series-wound 'bus-motor situated at the near end of the frame. This in turn drives the large dynamo (with rheostat on top), representing the loaded omnibus. By means of the rheostat the speed at which this machine will generate can be varied from 400 to 1,600 R.P.M., this representing the speed of the propeller shaft, and allowing for a variation of 'bus speed of from $4\frac{3}{4}$ to 19 miles per hour.

After extensive tests, the characteristic of the electrical equipment has been made to exactly coincide with the power characteristic of the petrol engine at varying speeds, and the result is a vehicle of extreme flexibility and simplicity of control.

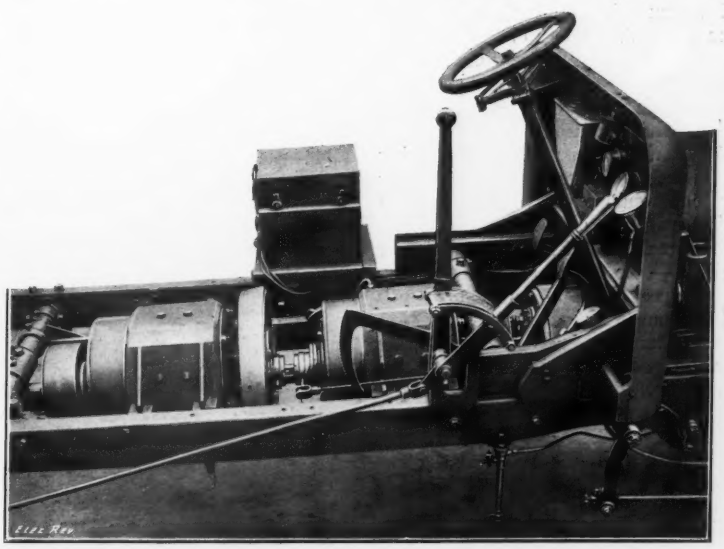
In conclusion, we are indebted to Messrs. Tilling for the opportunity of inspecting this notable addition to their fleet of 'buses ; also to Mr. Percy Frost Smith, their engineeer, and Mr. W. A. Stevens, for placing at our disposal their intimate knowledge of petrol-electric practice as applied to omnibus working. In view of Messrs. Tilling's long-standing connection with London omnibus traffic, one may be justifiably optimistic as to the working of the new vehicle, the results of which we shall look forward to.



THE TILLING PETROL-ELECTRIC 'BUS CHASSIS ; PLAN AND ELEVATION.

NOTES ON THE "THOMAS" TRANSMISSION SYSTEM.

A FEW weeks ago (ELECTRICAL REVIEW, May 5th, page 711) we described in detail the Thomas electro-mechanical transmission, consisting of an electrical drive in combination with a planetary gear, also a battery used for starting up the engine and lighting purposes. The transmission was at that time fitted to, among other vehicles, a 3-ton Leyland lorry for the purpose of undergoing a 2,000 miles R.A.C. test.

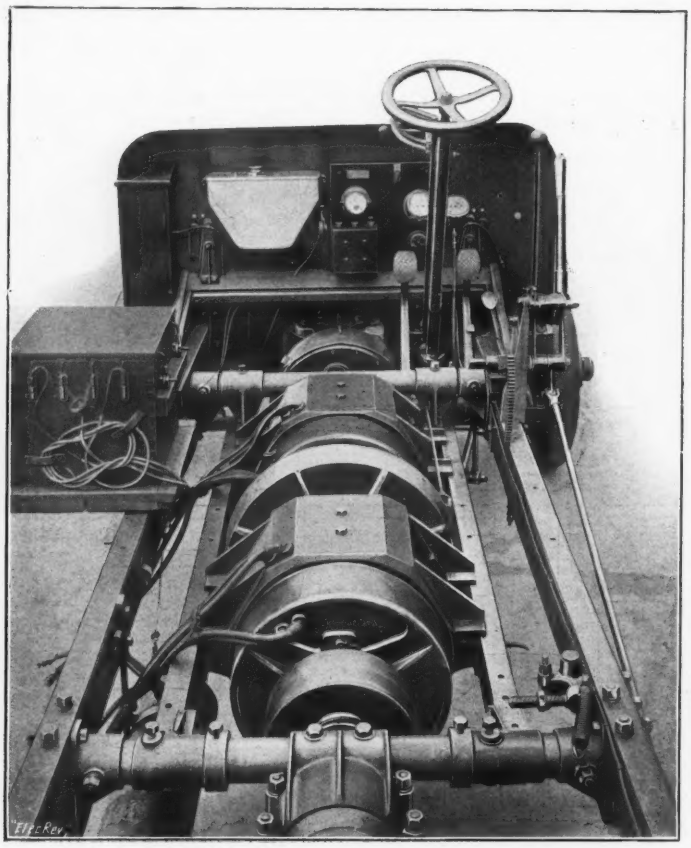


Controller removed ; battery behind and change-speed lever quadrant in foreground.

SIDE VIEW, THOMAS ELECTRO-MECHANICAL TRANSMISSION ON 30—40 H.P. LORRY.

That test has now been carried out over the exceedingly hilly route between Bromley Common and Cooper's Green, *via* Sevenoaks, Tunbridge Wells and Crowborough, and the following notes based on the R.A.C. report of the run may be of interest.

The average running weight of the lorry was 7·683 tons; it was fitted with a 36-H.P. engine (R.A.C. rating) giving a maximum of 42 H.P. at high speed. The trial was run night and day, and the speed of the lorry was not allowed to exceed 12 M.P.H., a factor which no doubt increased the fuel consumption on such a hilly route. As it was, an average running speed of 10½ M.P.H. was maintained, and the fuel consumption amounted to 265·8 gallons or 7·55 miles per gallon, which included the continual charging of the battery for engine starting and electric lighting.



Views showing electrical machines, clutch, fly-wheel, gear casing, &c. Controller removed; starting and lighting battery on left; change-speed lever quadrant on right.

THOMAS TRANSMISSION FITTED TO 30—40 H.P. LORRY.

Considering the route and limiting conditions, the average speed is higher than one would expect, but the official timing up Riverhill—which contains a good stretch of 1 in 10 and 1 in 11 gradient — on 18 occasions shows an average speed of 6·65 M.P.H. As regards fuel consumption, on a few hours' run as much as 9 miles to the gallon has been obtained, but naturally such a result could scarcely be maintained under night and day running conditions, and all things considered, 58 ton-miles to the gallon is an excellent result. The Thomas Transmission, Ltd., attach considerable importance to these results, owing to the fact that the efficiency of transmission from the engine to the road wheels can be fairly correctly estimated.

The road resistance per ton weight up Riverhill has on very good authority been estimated at 70 lb. per ton, and the tractive effort required to overcome road resistance would therefore be 538 lb., the vehicle and load being taken at 7·683 tons.

The length of the Riverhill gradient, 4,062 ft., and the total rise in the gradient, 300 ft., are based on the contour recorded by the R.A.C. for its official timing. From these the tractive effort required for the gradient is found to be 7·683 × 2,240 × 300/4,062, or 1,270 lb., and the total tractive effort required, 1,808 lb.

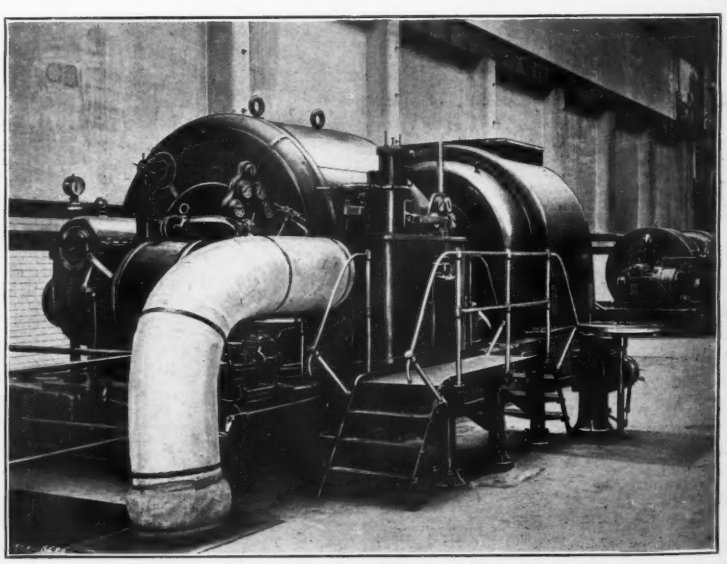
The maximum average speed up the hill, recorded by the R.A.C., was 7·206 M.P.H.,, and hence the horse-power at the road wheels was 1,808 × 7·206 × 5,280/60 × 33,000, or 34·8 H.P. Assuming the engine was giving its maximum power of 42 H.P. up the whole gradient, the average efficiency would then be 83 per cent. This figure not only includes the losses in the planetary gearing and two electrical machines, but also those in the bevil and spur wheels on the back axle. The average temperature rise of the electrical machines after the Riverhill climb was only 22° C. above the atmosphere. The engine was started from the battery about 80 times during the trial; and the electric lighting proved quite reliable, and no bulbs were replaced.

In addition to engine starting, a continual discharge of 8 amperes from the battery was maintained for 8 hours out of the 24 for lighting, and the 12-volt battery never dropped below 11·75 volts. The lamps comprised two-head (2·15 amperes each), two-side (·6 ampere each), two-dash and a tail lamp (about 2·2 amperes together).

As to the condition of the transmission after the trial, the R.A.C. report says it was found to be "very good, except that the teeth of the double-helical planetary wheels were found to be somewhat worn," and one or two brushes, sparking tips in the controller box required renewal (cost 18d.).

The planetary gear wheels had covered 4,000 miles at the end of the trial; they were of ·4 carbon and chrome nickel steel *unhardened*. Probably a harder steel would have shown no wear.

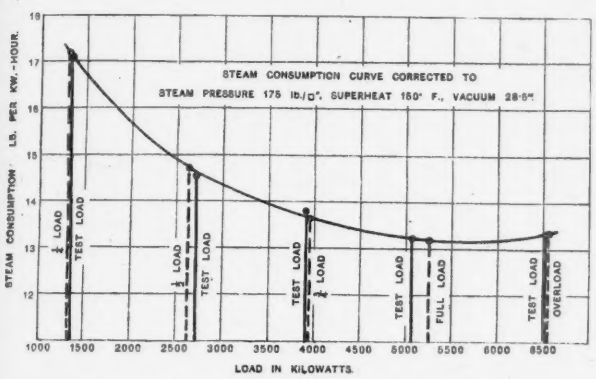
These results must be very gratifying to the Thomas Transmission, Ltd., the route chosen for the trial being probably as difficult a one as can be found, the profile showing 10 pronounced hills in every 36 miles travelled. We may add that the gear has been fitted to a Leyland 'bus, which in due course may be tried in London.



CLYDE VALLEY POWER CO.'S 5,000-KW. TURBINE UNIT (see page 1007).

TEST OF 5,000-KW. TURBO-ALTERNATOR.

THE tests of the new 5,000-KW. steam turbo-generator, one of two which the British Westinghouse Electric and Manufacturing Co., Ltd., is supplying to the Clyde Valley Electric Power Co., Glasgow, were carried out at the Motherwell power house on April 8th and 9th, 1911, in the presence of Mr. B. A. Starr, the general manager of the company, Messrs. Strain and Robertson, the consulting engineers, and other officials. The turbines are of the Westinghouse latest improved impulse type, arranged for working with high-pressure steam supplied direct from the boilers at 175 lb. per sq. in. pressure and 150° F. superheat, as measured at the stop valve.



STEAM CONSUMPTION CURVE, 5,000-KW. TURBINE.

The conditions specified for carrying out the tests were as follows: Normal output 5,000-KW. three-phase, 25 cycles, 11,000 volts; 25 per cent. overload for six hours, full load for six hours, three-quarter full load for two hours, one-half full load for two hours, and one-quarter full load for two hours. The tests work out as follows:—

Output, KW. ...	1,346	2,715	3,902	5,066	6,487·5
Speed, R.P.M. ...	1,500	1,500	1,500	1,500	1,500
Steam pressure, lb. per sq. in. ...	174	176	175	174·5	174·5
Steam temperature ...	518° F.	519° F.	542° F.	552° F.	544° F.
Steam superheat ...	141° F.	141° F.	164° F.	175° F.	167° F.
Vacuum corrected to 30 in. bar. ...	28·13	28·28	28·58	28·68	28·53
Cir. water inlet ...	43·9° F.	43·7° F.	44° F.	44° F.	43° F.
„ „ outlet ...	48° F.	52·6° F.	57° F.	60° F.	65·5° F.
Steam consumption, total lb. per hour	24.780	40,130	53,125	65,860	85,880
Steam consumption, lb. per KW.-hour	18·41	14·78	13·61	13·00	13·24

We understand that Mr. Starr, the general manager of the company, the consulting engineers, and the directors have expressed their gratification at the results obtained, and at the reduction of the generating costs, as shown by their records since the turbo-generator was put in commission.

The accompanying illustrations show a general view of the installation and the steam consumption curve.

THE ROYAL SOCIETY CONVERSAZIONE.

THE second annual conversazione of the Royal Society was held at Burlington House on the 14th inst. Most of the exhibits were shown at the last conversazione, and have already been described in the ELECTRICAL REVIEW.

In the Reception Room were exhibited the mace of the Royal Society, presented by King Charles II in 1663, also the Charter Book of the Royal Society containing the signature of the founder, and of the succeeding sovereigns who were patrons of the Society. An interesting object exhibited was a reflecting telescope made by Sir Isaac Newton in 1671.

In a joint exhibit by Prof. Silvanus Thompson and Prof. Coker, some interesting experiments with polarised light were demonstrated. The polarised light was produced by an inclined sheet of blackened glass, giving a field 12 in. square. In front of this field objects made of xylonite were subjected to stress, the effects of which were shown on looking at the objects through the analyser. A xylonite wheel running on a xylonite rail showed the lines of strain in the rail and in the rim and spokes of the wheel. Large plates of mica were used to produce circularly polarised light and to exhibit its effects.

Messrs. Elliott Bros. exhibited a gyrostat adapted to be used as a mariner's compass. The apparatus consisted of a gyrostat so suspended that its axis pointed to the true north, thus avoiding the necessity of any considerations of magnetic variation. The directive force is considerable, and on that account the apparatus can be made use of to transmit its indications to various points of a ship.

The Astronomer Royal exhibited a globe showing the motions of the two main star streams. The model was constructed to show how an examination of the directions of motion of the stars reveals the presence of two great streams of stars. The statistics of the motions in different parts of the sky are summarised by the diagrams on the globe; it can be seen that for each region there are two "favoured directions" of motion in which the stars move in greatest numbers. These directions are traced on the globe, and converge to two apices.

CONTRACTS OPEN.

(*Continued from page* 1002.)

Australia.—VICTORIA.—P.M.G.; 150 miles insulated wire and five miles of telegraph cable. See "Official Notices" June 16th.

July 19th.—Insulators, telephones, copper wire and iron wire, for the P.M.G.'s Department in Queensland. See "Official Notices" June 2nd.

August 8th.—Measuring instruments, telephone instruments, bells, &c., for the Deputy P.M.G., Melbourne. High Commissioner, 72, Victoria Street, S.W., and Board of Trade C.I. Department.

August 14th.—Dynamo and booster, storage battery, switchboard, wires and cables, for the Mortlake Butter and Cheese Factory Co., Ltd., Mortlake, Victoria. Specifications 10s. 6d., from F. A. McCarty & Co., consulting engineers, 31, Queen Street, Melbourne. A copy may be seen at Board of Trade C.I. Department in London.

BRISBANE.—July 19th. 199 tons of copper wire, and 180,000 porcelain insulators for the P.M.G.'s Department. High Commissioner's office, 72, Victoria Street, S.W., and Board of Trade C.I. Department.

BRISBANE.—January 30th, 1912. For the Metropolitan Water and Sewage Board:—One, two or three complete units, consisting of power-generating plant or plants, and pump or pumps, to raise from the suction wells through the delivery mains, through a total vertical lift of 400 ft., exclusive of the head due to friction, &c., not less than 6,000,000 British imperial gallons per day of 24 hours. Particulars from Mr. G. Johnston, secretary, office of the Board, Albert Street, Brisbane, Queensland.

Bolton.—June 26th. Tramway repairs shed for the T.C. Borough Engineer (returnable deposit, £5 5s.).

Canada.—July 3rd. One 125-K.V.A. generator, exciter and switchboard, tandem compound steam engine, 6 ft. × 16 ft. boiler and stack, cedar poles and line material and erection of same for the Town Commissioners of Stettler, Alberta. Engineers:—The John Galt Engineering Co., 317, Portage Avenue, Winnipeg.

Cardiff.—July 14th. Cables, economisers and induced draught installation, for the Corporation. "See Official Notices" to-day.

Charleville, Co. Cork.—June 30th. Suction gas plant, engine and generator, storage battery, &c., switchgear, overhead lines and street lamp fittings, for the Charleville Electric Co. See "Official Notices" June 16th.

Dublin.—July 5th. The Great Southern and Western Railway (Ireland) are inviting tenders for arc lamp carbons. Specifications and forms of tender, 6d. (not returnable), from the Storekeeper, Stores Department, Inchicore, Dublin.

Exmouth.—June 29th. Electrical appliances, for a year, for the Devon County Lunatic Asylum. H. E. Morgan, clerk the Asylum.

Govan.—June 27th. Steam and other piping, switchboard extensions, boiler, stoker, coal bunkers, and cooling tower, for the burgh electricity department. See "Official Notices" June 16th.

Grays.—June 29th. Steam coal for the electric light station, for the U.D.C. for a year. Electrical Engineer.

Heston and Isleworth.—July 5th. Electric lighting for certain schools for the Urban District Education Committee. Mr. P. E. Rycroft, Electricity Works, Hounslow.

Ipswich.—June 30th. Alterations to switchboard and other electrical plant, at the workhouse, for the B. of G. See "Official Notices" June 16th.

Italy.—July 11th. (*a*) Electric light bulbs and (*b*) lamp brackets of special type (estimated value £1,060), for the Royal Arsenal at Spezia. Deposit, £75 for (*a*) and £52 for (*b*). Local representation. Conditions and specifications (in Italian) at Board of Trade C.I. Department in London.

Kingston-upon-Hull.—June 26th. Cables and two water-tube boilers, for the Hull Corporation Electricity Department. See "Official Notices" June 16th.

London.—July 4th. Four electric traversers for car-sheds. See "Official Notices" May 26th.

June 30th.—Surface condensing plant at the South Kensington generating station, for H.M. Office of Works. See "Official Notices" June 2nd.

HAMMERSMITH.—June 30th. 600 time switches for individual street lamps, for the B.C. See "Official Notices" June 16th.

BATTERSEA.—June 30th. 440 street lighting lanterns for metallic-filament lamps, for the B.C. See "Official Notices" to-day.

Londonderry.—July 7th. Wiring, fittings, &c., for the new Guildhall lighting for the Corporation. See "Official Notices" June 16th.

New Zealand.—August 4th (not 14th) is the date for receipt of tenders by the Gonville and Castlecliff Tramway Board of Wanganui, mentioned here last week. A specification may be seen at the Board of Trade C.I. Department in London.

Manchester.—June 27th. Two water-tube boilers with superheaters, coal chutes, ash conveyor and fuel economisers, for the Corporation Electricity Department. See "Official Notices" June 9th.

Rochdale.—June 26th. Car-shed, for the T.C., at Bacup. J. S. D. Moffet, engineer, tramway offices, Mellor Street, Rochdale (returnable deposit of £2 2s.).

Rotherham.—July 8th. Single vulcanised bitumen-covered cable (various sizes), smudge or pea nuts for a year from October 1st, and meters; Borough Electrical Engineer. Also stores and materials for the tramways department for a year. Tramways Manager.

Southampton.—The T.C. is to place an order with Messrs. Cole, Marchant & Morley for an air pump, at £262.

Spain.—June 30th. Tenders are being invited by the municipal authorities of Toro (province of Zamora) for the concession for the electric lighting of the town during a period of 25 years.

July 4th.—Tenders are wanted by the "Sección Colonial del Ministerio de Estado," Madrid, for the complete installation of a wireless telegraph station on the island of Fernando Po, for the purpose of carrying on telegraphic communications in the Gulf of Guinea. The cost of the station is estimated at 62,150 pesetas (about £2,300), excluding excavation and foundation work. This call for tenders is reserved to Spanish firms, but should no award be made, a second adjudication will take place to which foreign firms will be admitted. In this latter event Spanish firms will be allowed a preferential margin not exceeding 10 per cent. over foreign estimates.—*Board of Trade Journal.*

Swinford.—July 10th. Suction gas plants, engines and dynamos, storage battery, &c., switchboard, overhead lines and street lamps for the R.D.C. See "Official Notices" to-day

CLOSED.

Barnsley.—The T.C. has accepted the following tenders:—

Willans & Robinson, Ltd.—Steam turbo-generator complete with condenser and Siemens dynamo.
Clarke, Chapman & Co., Ltd.—Water-tube boiler and fittings.
Davenport Engineering Co.—Water-cooling tower.
W. Lucy & Co., Ltd.—Lamp columns and fittings.

Burnley.—The Corporation has placed an order for two ventilating fans, at £65, with J. Keith & Blackman Co.

Frome.—The U.D.C. has accepted the tender of Messrs. Dawson & Manfield for a refuse destructor, at £1,893.

Heywood.—The Electricity Committee has accepted the following tenders:—

Parker & Calvert.—Cable boxes.
McFarlane & Co.—Boiler composition.
T. Isherwood & Co.—Cotton waste.

Leek.—The U.D.C. has accepted the tender of Robert Heath & Sons for 6,000 tons of Birchenwood washed nuts; and that of Wilson, Carter & Pearson for 1,000 tons of Silverdale washed nuts.

London.—HAMMERSMITH.—The tender of the Alphons Custodis Chimney Construction Co., for the erection of a chimney stack for the generating station extension, is recommended for acceptance, at £393. For steam and feed-water pipes, &c., the tender of Messrs. Aiton & Co., at £1,568, is recommended.

Nelson.—The T.C. on June 15th considered an offer from the Tudor Accumulator Co. for the replating of the storage battery and its general maintenance for a period of 10 years, and also for the supply of a booster-balancer machine and switchgear. The terms of the company were accepted.

Oxford.—Messrs. Hill, Upton & Co., of Oxford, have secured the contract for the electrical illumination of the Town Hall for the Coronation.

Stoke-on-Trent.—The B. of G. has accepted the tender of the National Telephone Co. for the installation of fire-alarms, at £130, with six months' free maintenance.

Stroud (Glos.).—The U.D.C. has accepted the tender of Messrs. Manlove, Alliott & Co. for a refuse destructor.

Sunderland.—The T.C. on the 14th inst. accepted the following tenders:—

Crewdson, Hardy & Co.—Wrought-iron pipes.
Aiton & Co.—Cast-iron pipes.
Ferranti, Ltd.—Meters.

FORTHCOMING EVENTS.

Incorporated Municipal Electrical Association.—Tuesday, Wednesday, Thursday and Friday, June 27th—30th. At Brighton and Portsmouth. Annual convention. For particulars of papers, &c., see our issue of May 18th.

Institution of Civil Engineers.—Wednesday and Thursday, June 28th and 29th. Conference on "The Education and Training of Engineers."

Physical Society.—Friday, June 30th. At 5 p.m. At the Imperial College of Science. Papers "On the Effect of a Narrow Saw-cut in the Edge of a Conducting Strip on the Stream Lines in the Strip and on the Resistance of the Strip," by Prof. C. H. Lees; "The Capacity Coefficients of Spherical Electrodes," by Dr. A. Russell; and "Exhibition of the Benkö Primary Battery," by Mr. W. R. Cooper.

NOTES.

Water-power Legislation in Norway.—The new Bill regarding the regulation or utilisation of water-powers in Norway has now been settled by the Upper House, and as the Lower House will arrive at the same decision, a Christiania correspondent states that it is certain the Bill will pass into law in the form adopted by the Upper House. It is provided, in the first place, that concessions must be obtained in most cases to carry out works of regulation. The State itself can undertake the work when required in the public interest, although the regulated water-power can be transferred to private enterprise in return for a reimbursement of the expenses of regulation. The measure contemplates the imposition of a tax of not less than 1·32d., and not more than 1s. 1½d. per horse-power in the case of all works which have over 1,000 H.P. in operation, the tax being payable to the communes. It is, however, provided that the tax can be reduced for a definite period or be entirely abolished, but either arrangement will be subject to an agreement with Parliament. The duration of concessions is to range from 60 to 80 years, although Norwegian local authorities and enterprises proved to be of a purely Norwegian character can be granted unlimited concessions if not prejudicial to the public interest. If the expropriation of an undertaking is required in the public interest on the expiration of the concession, the invested capital is to be compensated and receive an addition of 25 per cent. If the large lakes are utilised where the shores are not the complete property of the hydro-electric enterprise, the amount of 2s. 2½d. must be paid once for every horse-power as a tax, which is to be equally divided between the State and the interested communes. As a consequence of the new measure, it is considered that a further law will be necessary in order to place a tax upon existing water-powers which are already in use, so that these may be put on a level with new concessions from this particular point of view.

The Telephone Transfer.—On Monday last an important debate took place in the House of Commons on the money resolution for the transfer of the National Telephone Co.'s undertaking to the Post Office. Mr. Samuel stated that, owing to the great divergence of views as to the value of the plant, arbitration would be necessary. The capital already expended by the Post Office amounted to nearly 5½ millions on the trunk system, and 5 millions on the Post Office telephone system, with which more than 100,000 telephones were connected. The Treasury possessed powers to spend another 2 millions, and he now asked for an additional sum of 4 millions over and above what might be required to purchase the company's plant, for the future development of the trunk and local services. The whole of the company's staff would be taken over by the Post Office, without decrease of wages, and their period of service with the company would be taken into account in deciding seniority. Further details must be held over to our next issue. The resolution was agreed to.

International Congress at Turin.—The General Rules for the International Congress of the Applications of Electricity, to be held at Turin, September 10th to 17th, 1911, have now been issued, and can be obtained from the Congresso di Elettricità, Politecnico, Turin.

Institution and Lecture Notes. — A paper on "Luminous Electric Mine Shaft Signalling" was read by Mr. J. C. Eadie, before the members of the MANCHESTER GEOLOGICAL AND MINING SOCIETY at their monthly meeting on the 13th inst.

PHYSICAL SOCIETY OF LONDON.—At the meeting held on June 9th, 1911, a paper on "A New Method of Harmonic Analysis by Averaging Selected Ordinates" was read by Prof. S. P. Thompson.

Assume with Fourier that the curve representing any periodic single-valued function of x may be expressed by the harmonic series

$$y = A_1 \sin x + A_2 \sin 2x + A_3 \sin 3x + \ldots\ldots + B_1 \cos x + B_2 \cos 2x + B_3 \cos 3x + \ldots\ldots$$

Then to find the coefficient of any term, A_n or B_n, it suffices—subject to a limitation stated below—to measure off on the curve $2n$ equidistant ordinates over one period, that is, spaced at successive intervals apart of π/n. Then, having reversed the sign of every alternate ordinate, the simple algebraic mean of them gives the coefficient sought. For cosine-coefficients the first ordinate must be taken at the origin; while for sine-coefficients the first ordinate must be taken at a point $\frac{1}{2}\frac{\pi}{n}$ from the origin. In symbols this is—

$$A_n = \frac{1}{2n}\left\{ y_{\frac{1}{2}\pi/n} - y_{\frac{3}{2}\pi/n} + y_{\frac{5}{2}\pi/n} - y_{\frac{7}{2}\pi/n} + \ldots\ldots - y_{\frac{4n-1}{2}\pi/n} \right\};$$

$$B_n = \frac{1}{2n}\left\{ y_o - y_{\pi/n} + y_{2\pi/n} - y_{3\pi/n} + \ldots\ldots - y_{(2n-1)\pi/n} \right\}.$$

The limitation is that if, in finding the nth harmonic, there be present also the $3n$th, or the $5n$th, or the $7n$th, &c., these will be included in the average found by the process, and must, if present, be separately determined and eliminated.

The process is much facilitated by the use of templates of transparent celluloid having equi-spaced vertical lines engraved upon them. They are laid down on the curve, and the values of the selected ordinates are thus readily measured off. For analysis of valve-motions, of alternating-current curves, of tidal observations, and diurnal magnetic variations, the method presents certain advantages, as it requires no multiplication of ordinates by sines or cosines.

A paper on "The Measurement of Contact Differences of Potential," by Prof. A. Anderson and Mr. J. E. Bowen, was taken as read.

Royal Visit to Bombay.—The *Calcutta Englishman* of May 25th says that the Government of Bombay have entrusted to Messrs. Marshall & Co., electrical engineers, the contract for illuminating by electricity all Government buildings on the occasion of the visit of the King-Emperor and Queen-Empress to India. The scheme to be employed is the Fairyland system of electric illuminations. At the Apollo Bunder an amphitheatre, which is to be specially erected for the reception of their Majesties, will be illuminated on similar lines, and it is hoped that such beautiful mansions as adorn the Fort and the Victoria Terminus and B.B. and C.I. Railway head offices, &c., will follow the example set by Government. The Bombay Electric Supply and Tramways Co. will supply the necessary power.

Legal.—POTTS *v.* METROPOLITAN DISTRICT RAILWAY.—At the Westminster County Court on 16th inst., a jury awarded £50 damages and costs to W. Potts, a joiner, in respect of injuries consequent upon an electrical shock received when he put his foot into a puddle on the platform at Putney Bridge Station. According to the *Times* report there was a leakage of current through the covering of the cable supplying the live rail.

BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., *v.* THE ELECTRICAL CO., LTD.—In the Chancery Division on Saturday last Mr. Justice Swinfen Eady gave his considered judgment in the above action. He came to the conclusion that the plaintiffs should succeed, and were entitled to the relief they claimed, and he granted an injunction, an inquiry as to damages and delivery up, and a certificate of the particulars of breaches.

Edinburgh Empire Theatre Disaster. — Evidence regarding the use of electric fittings on the stage was given last Thursday at the public inquiry, held before Sheriff Maconochie and a jury at Edinburgh, into the circumstances associated with the recent Empire Theatre fire. Ten deaths, it may be remembered, resulted from the disaster, including that of the illusionist, "The Great Lafayette."

Mr. G. M. Sinclair, stage manager, in the course of his evidence, said that Lafayette brought a considerable quantity of scenery and electric fittings. He had a stage manager and an electrician of his own. The supply of electricity was given by the Theatre Co. In "The Lion's Bride" there was a curtain roof, so to speak, on the stage, and hanging below this canopy roof was a lantern. Holes had been bored in the lantern and covered with gelatine material, and inside there were seven coloured electric lamps The electricity was supplied by means of a wire from the prompt side. There were a number of other electric light fittings on the stage. There were two sets of seven wax candles also. He was satisfied that the fire had nothing to do with any of the fittings on the stage. Mr. Sinclair then described the scene when the fire broke out, and told how Lafayette's electrician ran out from the stage and let go the iron curtain.

A juryman asked witness whether Lafayette's arrangements modified in any way the usual custom of the theatre as regards electric lighting or persons on the stage, and the manager answered that everybody connected with the theatre had to leave the stage.

Mr. Ebenezer Wood Bussell, who did scenic work for Lafayette, described the lantern already referred to. Open at both ends, it was covered with canvas with holes made in it. The holes were covered with gelatine, while inside the lantern were seven electric lamps. He was in the theatre when the fire broke out, and observed flame running along the communicating wire of the lantern. There was no other light in contact with the canopy. Answering the Sheriff, witness said he did not think the fire had been caused by the lamps swinging against the gelatine cover.

Samuel Lloyd, theatre manager, Glasgow, said he first noticed an extraordinary light at the top of the lantern, but he could not say what caused it. It was quite customary to line lanterns with gelatine. He thought the gelatine was the least likely to take fire.

Eugene Cawood, electrician, said he supplied the cable which was used for Lafayette's performance. Asked whether from his experience of electricity he could express any opinion as to how the fire might have originated, assuming that it occurred in connection with the lantern, he replied that the only thing he could think of was a faulty joint inside the lamp.

Mr. Sidney E. Merrick, electrician to the Lafayette company, said he had been using the lantern in question for some time previously to the fire, and it was working quite satisfactorily. He considered that the electric cable supplied was perfectly suitable.

Mr. Frank A. Newington, Corporation electrical engineer, said the fire might have been caused by the fusing of one or other of the wires in connection with the lantern. The cable was quite satisfactory for the purpose.

Sheriff Maconochie, addressing the jury, said he thought the evidence came to this, that for one reason or another there was a fusing at the place where the flexible cord was attached to the lantern, or at some of the points inside the lantern, and that the india-rubber insulation caught fire, and then dropped down on the inflammable material or touched the scene hung about it. Several experts had told them the wire was sufficient to carry seven lamps of 8 C.P. They had also the testimony of fact that the wire had borne the lantern for a number of times. There was not a shred of evidence to entitle them to say that it was exposed to rough usage. If they took that view of the evidence, there was no doubt the verdict should be that the cable was sufficient, and that the precautions taken were proper.

The jury returned a formal verdict to the effect that the victims were suffocated or burned, with the recommendation that in future the city authorities should exercise more scrupulous care, both in regard to the safe construction of theatres and to more frequent examination of electric light fittings and water hydrants.

Mill Electrification.—Mr. Francis Mather, the proprietor of Whitefield Weaving, Doubling and Winding Mills, has engaged Messrs. Lacey & Sillar to design a scheme for the electric driving of his mill, with a view to taking power from the Lancashire Electric Power Co.

Appointment Vacant.—Improver, to assist on mains and switchboard, for the Beckenham U.D.C. Electricity Department (15s.). See our advertisement pages in this issue.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—On the occasion of his leaving, MR. H. W. GREGORY, assistant engineer to the North Metropolitan Electric Power Supply undertaking at Tottenham, was presented with a despatch-case and slide-rule by the Tottenham staff. He has been appointed a power representative under the Corporation of West Ham in their southern district.

The Electricity Committee of Southampton Town Council has considered an application from MR. J. B. B. HOWAT, station engineer, for an increase in his salary of £200 per annum, and has decided in favour of a bonus of £10 being granted to Mr. Howat for extra duties in connection with the erection of additional plant, and that his salary be increased to £215 per annum.

MR. E. TAYLOR, fourth engineer-in-charge at the Hammersmith B.C. electricity works, has resigned upon receiving an appointment under the Board of Trade, and a successor at £130 per annum is to be advertised for.

MR. J. EDWIN STORR has been appointed to the vacancy on the staff of the Yorkshire Electric Power Co., occasioned by the resignation of Mr. H. M. Sillar.

General.—The Council of the Royal Society of Arts has awarded the Albert Medal of the Society for the current year to the HON. CHARLES A. PARSONS, C.B., LL.D., D.Sc., F.R.S., for his experimental researches into the laws governing the efficient action of steam in engines of the turbine type, and for his invention of the reaction type of steam turbine and its practical applications to the generation of electricity, the ventilation of mines and other large spaces, blast-furnace work, ship propulsion, and other important purposes.

SIR JOSEPH WILSON SWAN has been elected president of the Newcastle Literary and Philosophical Society, in succession to the late Right Hon. D. R. Spence-Watson.

NEW COMPANIES REGISTERED.

Jacob White & Co., Ltd. (116,217).—This company was registered on June 3rd, with a capital of £2,000 in £1 shares, to carry on the business of electricians, manufacturers of and dealers in accessories, fittings and supplies, whether used in connection with engineering or with locomotion of any kind or otherwise, lighting engineers, electrical contractors, &c. The subscribers (with one share each) are:—E. W. White, 28, Cloudsley Street, Islington, N., electrical engineer; T. Jacob, Rhydyfrau, Elstree Hill, Middlesex, electrical engineer. Private company. The number of directors is not to be less than two or more than three; the first are T. Jacob and E. W. White (both permanent); qualification, 100 shares; remuneration as fixed by the company. Registered office, King's House, King Street, E.C.

Canadian P. J. Mitchell Co., Ltd. (116,323).—This company was registered on June 14th, with a capital of £21,000 in 20,000 preference shares of £1 each and 20,000 ordinary shares of 1s. each, to carry on the business of exporters and importers of and dealers in machinery, tools and plant, general electrical and mechanical engineers, contractors, ironfounders, &c. The subscribers (with one share each) are:—Col. A. Durand, 31, Park Lane, W., Director, East London Railway; P. H. Brown, 5, New Square, Lincoln's Inn, W.C., barrister; P. J. Mitchell, Caxton House, Westminster, S.W., accountant; A. P. Smith, 20, Draycott Place, S.W., civil engineer; D. Bennett, 190, Revelstoke Road, Southfields, S.W., engineer: R. H. Barr, 5, Temple Fortune Hill, Hendon, N.W., engineer; H. W. Horsman, 200, Mayall Road, Herne Hill, S.E., clerk. Minimum cash subscription 5,000 shares. The number of directors is not to be less than three or more than five; the first are Col. A. Durand, P. H. Brown and P. J. Mitchell; qualification (except first directors), £100; remuneration, £50 each per annum. Registered office, Caxton House, Westminster, SW.

Cavendish Electrical Co., Ltd. (116,324).—This company was registered on June 13th, with a capital of £5,000 in £1 shares, to carry on the business of manufacturers of and dealers in scientific, medical and surgical apparatus, including X-ray, high frequency, light and heat apparatus, Finsen lamps, vibrators, nebulisers, hot air and steam baths, douches, physical exercise and massage appliances. The subscribers (with one share each) are:—W. E. S. Wissler, 59, Eastcheap, E.C., company director; A. R. Winterson, 185, Brooke Road, N.E., electrical engineer; E. H. Willis, 14, Kitts Road, St. Catherine's Park, S.E., electrical engineer. Private company. The number of directors is not to be less than three or more than five; the first are W. E. S. Wissler, A. R. Winterson, E. H. Willis and J. Richert; qualification, £100. Registered office, 190, Great Portland Street, W.

CITY NOTES.

Victoria Falls and Transvaal Power Co., Ltd.

THE MARQUIS OF WINCHESTER (chairman) presided on Monday at Salisbury House, E.C., over the ordinary general meeting of the above company.

A part abstract of the directors' report appeared in our issue of June 9th. The report also contained the following statements:—

"The profit shown in the accounts has been secured from sale of power from the Brakpan and Simmer Pan stations only. The larger Rosherville station did not commence supply until March of the present year, so that no profits accrued to this company in respect of its holding in the Rand Mines Power Supply Co., Ltd., which company will supply the demands of the Rand Mines, Ltd., both in compressed air and electricity. In accordance with the provisions of the Power Undertakings Act, 1910, passed by the late Legislative Council and Legislative Assembly of the Transvaal, the Governor-General of the Union of South Africa has granted a licence to the company superseding the previous concessions granted by the Governments of the late South African Republic and of the Transvaal Colony. This licence permits the supply of power up to 500 million units annually, and the conditions of supply are in accordance with the contracts previously entered into by the company with the various consumers. This licence enables the company to erect at Vereeniging on the Vaal River a further station for the generation of power and to erect transmission lines from there to the Rand. A licence has also been granted to the Rand Mines Power Supply Co., Ltd., permitting the supply of power up to 600 million units annually. When the two extension sets at Simmer Pan came into operation the company was enabled to close down the old Driehoek station. The results obtained from the new stations continue to give entire satisfaction as regards coal consumption and cost of production. Transmission lines are now completed and in operation from the West Rand Consolidated on the west to Brakpan on the east of the Witwatersrand, a distance of 52 miles. The air pipe transmission lines belonging to the Rand Mines Power Supply Co., Ltd., are completed from the Crown Mines on the west to Glen Deep on the east, and the supply of compressed air through this system to the mines of the Rand Mines, Ltd., has commenced. Active operations are in progress at Vereeniging. This station is being erected to accommodate two sets each of 15,000 H.P. capacity. The foundations and water supplies are being at the same time arranged, so that in the event of the engineers deciding that the increasing demands of the mining industry for power warrant the expenditure, further additional sets can be expeditiously installed. The South African management consists of Major the Hon. Walter L. Bagot, D.S.O., general manager; Bernard Price, chief engineer; Walter E. Goldby, financial manager. An agreement has been entered into between the company and the Rand Mines Power Supply Co., Ltd., by which the entire management of the latter company is placed in the hands of this company."

The CHAIRMAN, in moving the adoption of the report, said the share capital on December 31st, 1910, was £2,838,000, made up of 1,000,000 ordinary shares and 1,838,000 preference shares, as against 1,708,000 last year; an increase of 130,000 shares. These shares had been issued to certain of the mining groups who were now consumers of power. A small amount at the date of making up these accounts was outstanding—these shares had since been forfeited and reissued to the guarantors on their paying up the balance owing thereon—the figure of £1,838,000 was therefore correct. Since the date of the report a further £162,000 preference shares had been issued. The preference capital issued was now £2,000,000. Last year he told them that the subscription of an additional £900,000 5 per cent. debentures had been arranged for, thus bringing the amount of the loan capital up to £1,700,000. The Dresdner Bank and Deutsche Bank had agreed to take from them a further £1,000,000 of 5 per cent. debentures. Their financial requirements demanded, however, that they should issue the balance of £300,000, and the banks had agreed to include these in their impending issue. The debentures now to be offered would, therefore, amount to £1,300,000, thus increasing the loan capital to £3,000,000, the full amount of their authorised issue. Last year he informed them that the total share and debenture issue was £4,538,000, and they might now take it as being £6,000,000, made up as follows:—Ordinary shares, £1,000,000; preference 6 per cent. shares, £2,000,000; and first mortgage 5 per cent. debentures, £3,000,000. On the same side of the balance-sheet appeared creditors £429,201, which included debenture interest for the year to December 31st, 1910; contractors' accounts—London and South Africa—amounts owing but not paid as on December 31st, £354,056, contractors' retention fund £114,267, and interest thereon, which, as it was not the property of the company, was shown on both sides of the account. For the same reason the sum of £42,796 appeared on the creditors' side; this amount was a part of £75,144 on the debtors' side, but was shown as being in the hands of the Dresdner Bank in Berlin, to meet the debenture interest due January 2nd of this year. On the creditor side, purchases of leases, concessions and undertakings had been increased from the figure of 1909 by £251. After deducting the amount written off for depreciation—£30,562—these items stood in the books at £1,643,769, as against £1,674,080 last year, a decrease of £30,211. Expenditure on and in connection with new stations, after increasing the 1909 figure of £1,195,228 by £334,561, and deducting amount chargeable to depreciation £67,610, stood at £1,462,179, as against £1,195,228, an increase of £266,951, but if they considered that they had actually added by expenditure, plant amounting to £327,977, their new stations really stood in the books at a reduced figure from the previous year. Debtors, London and South Africa, £31,437, had since been paid with the exception of £422, but that amount was guaranteed. They held all the share capital of the Rand Mines Power Supply Co. The scheme of finance was 500,000 ordinary shares and a loan capital of £1,300,000. As they had transferred plant to that company in excess of the latter amount by £340,394, the sum of £292,394 would be allocated in paying up the balance of the calls, as such calls were made on the 500,000 shares. Due provision had been made for depreciation on stores, furniture, live stock and vehicles, &c., and preliminary expenses. Turning now to the profit and loss account, they would see the balance for the year under review, being profit, amounted to £157,749. In the appropriation account this profit was added to the carry forward from last year, and they found themselves in possession of a sum of £210,597, after payment of the debenture interest for the year under review. Their first duty was to provide for depreciation under the headings he had previously referred to. To this purpose they devoted a total sum of £114,850 to cover the period from December, 1906, to 1910 (no depreciation having been previously taken into account). This left them with a balance of £95,747. Out of this balance they, in accordance with the terms of the articles of association, declared a dividend at the rate of 6 per cent. per annum on the preference shares for the time being paid up from January 1st, 1909, to October 14th, 1909, and a further amount at the rate of 1 per cent. per annum from October 17th to December 31st, 1908 (5 per cent. having been already paid for that period in accordance with the British South Africa Co.'s undertaking). This additional 1 per cent. fulfilled the condition as expressed in the memorandum of association, Clause 6. If they recalled what he said last year, he told them that by the middle of 1911 the plant at Rosherville of the Rand Mines Power Supply Co. would be in commission and earning profits, and it would then be possible to consider the rights of their shareholders. He trusted they would consider that they had fulfilled that expectation. This distribution would absorb £57,897, leaving a sum of £37,849 to be carried forward. He would offer an apology for the insertion in the report of the word "approximately," which was used in connection with the amounts distributed and carried forward. Owing to the banks being desirous to make the debenture issue early in June, they were obliged, in order to meet the requirements of the Committee of the Berlin Stock Exchange, to furnish the banks with their balance-sheet. They were anxious that the shareholders should not obtain first information of the affairs of the undertaking through the columns of the financial Press, and so they expedited the placing of the report in their hands. As they had some 4,000 shareholders, the time was insufficient, after the board had decided the sum to be distributed, to have the exact amount due to each shareholder made out and the correct figure stated in the report and at the same time keep ahead of the publication of the report and balance-sheet in Germany. They therefore inserted approximate amounts, and the figures which he had now given were the corrected amounts. To sum up the results, they had provided for reasonable depreciation, they had made a commencement in the payment of a preference dividend, and they had carried forward a sufficient sum for the requirements of the company. In anticipating a question, why such a period as 9½ months had been chosen over which they had declared the dividend, let him say this period had been selected because it brought their 1906 and 1909 issues of preference capital into line, and left the amount to be carried forward at a reasonable sum. There would now be only one quotation for their settled shares. Their profits had been secured by the work of the stations, Brak-

pan and Simmer Pan. These were erected almost entirely out of the moneys provided by the early preference and debenture issue. Besides providing for depreciation during the year, £38,963, and £82,550 for interest and income-tax on debentures, a total of £121,513, they had earned during the year under review an additional amount almost equal to the carry forward for the year, or, if they looked at it another way, their realised profit was £157,749, while their total debenture interest would amount to £150,000. Thus, the plant of the Brakpan and Simmer Pan stations, equivalent to about one-third of the larger output of the Rosherville and Vereeniging stations, were equal to meeting the interest demands of their whole debenture capital, leaving the profits on the shares and loan capital of the Rand Mines Power Supply Co. to provide for depreciation, amortisation and interest on share capital. The Power Undertakings Act, 1910, resulted in their having to exchange their concession for a definite licence; this licence would enable them to carry on the business under statutory powers for the full period by which they were safeguarded by their concession. A further licence had been acquired by the Rand Mines Power Supply Co. Active operations were in progress at Vereeniging. This station was being erected to accommodate two sets each of 15,000 H.P. capacity. The foundations and water supplies were being so arranged that, in the event of the engineers deciding that the increasing demands for power of the mining industry warranted the expenditure, further additional sets could be expeditiously installed. Should the recommendations of their engineers necessitate any large increase, it would require that power be taken to increase the capital of the company. He did not, however, anticipate that it would be necessary, but the policy of the mining industry was in the direction of amalgamation coupled with big installations for reduction purposes, and it would not do to blind their eyes to the fact that, large as the business which they had secured for them was, there might in the future be considerable expansion. The recent speech by the chairman of the Rand Mines, Ltd., displayed no anxiety as to the life of the industry as a whole. Undoubtedly a saving in costs would follow the conversion of reduction plants to the electrical drive; this would bring large quantities of ore hitherto considered unpayable within the limit of pay ore, and would thus increase in some instances the life of certain of the mines. Their asset in the Victoria Falls still remained in the background for future exploitation. They were not unmindful of its value, and the process for the treatment of the lead and zinc and copper ores of the north might yet provide them with a fertile source of profit. The management in South Africa was still in the capable hands of Major the Honourable Walter Bagot—who was with them that day—and he was ably assisted by Mr. Walter E. Goldby as financial manager; and as chief engineer, Mr. Bernard Price had amply fulfilled their expectations. When they considered that their undertaking now consisted of four erected stations, one in course of erection, transmission lines extending for a distance equal to from London to Brighton, and that shortly when the Vereeniging station was in operation, it would mean an additional transmission system equal to the distance from London to Reading, together with a compressed air system equivalent to a pipe line from London to Watford and back, that the total tons crushed on the Rand during 1910 were 21,500,000 tons, and that their undertaking was responsible for providing nearly the whole of the power required for the reduction of 63 per cent. of this tonnage, they would appreciate the magnitude of the undertaking and the responsibilities of the staff. He should not be doing his duty if he did not also mention the excellent work of their managing director, Mr. A. E. Hadley. Their contractors, in spite of a serious delay caused by the total loss of the steamship *Khedive*, off East London, which had on board a large consignment of their machinery, had maintained their delivery of plant, and the Rosherville station was now almost completed, not exactly on the date anticipated, but, taking into consideration that the action of the then Government of the Transvaal through the introduction of the Power Bill, 1910, coupled with the shipwreck before mentioned, caused delay beyond their control, he was satisfied that on their schedule of time they had no reason to complain. This was the first occasion on which they had been able to meet them with a sufficient surplus to enable them to commence to make a return upon their investment. The company had now been in existence some 4½ years; during that time they had been laying the foundations of a business of great magnitude. Their business was assured, their customers' demands must be for many years steady, and possibly increasing, and it would, he hoped, be his pleasing duty next year to meet them with a statement showing continued and satisfactory progress.

MR. H. BIRCHENOUGH, C.M.G., seconded the motion, and the report was adopted without discussion.

Felten & Guilleaume-Carlswerk.

THE above is the title of the undertaking formerly known as the Felten & Guilleaume-Lahmeyerwerke Actien Gesellschaft, of Mulheim on the Rhine. During 1910, as will be remembered, the company became associated with the A.E.G., and also disposed of its dynamo works to a separate company having a share capital of £500,000 and a reserve fund of £150,000. The report of the directors of the Felten & Guilleaume Co., which has just been issued for 1910, states that the economic development in general continued in a quiet and satisfactory way, particularly in regard to the Carlswerk, and the value of the orders received and deliveries made was 10 per cent. larger than in 1909, and the results also improved. The degree of employment in the Frankfort department also experienced a considerable increase until the announcement of the proposed transfer was made, when business first became difficult and then declined, thus again unfavourably influencing the accounts of the department. According to the agreement entered into with the A.E.G., the Felten & Guilleaume Co. was spared a loss in the transfer of the assets of the Frankfort department, but on the other hand, it had been believed that by suitable internal reserves, cover could be provided for the expenses incurred in carrying out the whole of the transaction. The considerable loss in the Frankfort works in 1909 had, however, only been partly overtaken. The Società Au Forza, whose share capital had been fully paid by the company, had temporarily given rise to some concern, but as a result of the accommodating attitude of large shareholders, the company's risk had been disposed of at a small sacrifice. The investments, on the whole, continued to yield satisfactory results. The accounts indicate the following figures, the profits from manufacturing not being shown separately from the revenue from investments:—

	1910.	1909.
Share capital	£2,750,000	£2,750,000
Gross profits	570,000	694,000
General expenses...	202,000	292,000
Depreciation	113,000	114,000
Net profits and balance forward	142,000	203,000
Dividend	110,000	165,000
„ per cent.	4	6

The dividend in 1908 was at the rate of 8 per cent., in 1907, 10 per cent., and in 1906, 11 per cent. The report states that the cable factory at the Carlswerk continued well employed in regard to cables for heavy currents during 1910, but the results did not substantially improve, as large quantities of cable had still to be delivered at the very low prices which were accepted during the temporary collapse of the Cable Syndicate. On the other hand, business in telephone and telegraph cables was quiet, owing to the limitation of the requirements of the Imperial postal authorities. The number of machines ordered from and delivered by the Frankfort dynamo works was considerably greater than in 1909, the deliveries being 14,488 of 485,000 H.P., as against 11,220 of 450,000 H.P. in 1909. The directors remark in conclusion that they believe account has so far been taken of the sacrifices associated with the disposal of the dynamo works that only the good results of the transaction should prevail for 1911 and subsequently.

French Electrical Companies.

THE Compagnie Continentale Edison records profits of £134,000 for 1910, as compared with £210,000 in the previous year, and contemplates the payment of £4 4s. per share, as against £5 4s. in 1909. The supplies of electricity by the Union des Secteurs, to which the Edison Co. belongs until the transfer to the Compagnie de Distribution at the end of 1913, only experienced a slight increase in 1910, as the inundations, the earlier closing of shops, and the introduction of more economical lamps, caused a considerable decline on the one hand, although this was compensated for by the accession of new consumers on the other.

The Compagnie Française Thomson-Houston, of Paris, realised gross profits of £273,000 in 1910, as contrasted with £246,000 in 1909 on an ordinary share capital of £2,400,000, apart from bond capital totalling £1,150,000. As net profits the accounts indicate the amount of £154,000, as against £146,000 in the previous year, and a dividend of £1 4s. per share has been declared, being the same as in 1909. At the annual meeting it was mentioned that the orders on hand on January 1st, 1911, represented £672,000, and these were increased by £648,000 by the end of April. The contracts referred to the conversion of tramways in Paris, and the electrification of some railways, and the company was, therefore, fully employed. The prices in the electrical trade were much depressed owing to keen competition, although the large capital at the company's disposal permitted of the grant of long credit, and thus facilitated business in many instances.

The Ateliers de Constructions Electriques du Nord et de l'Est, of Jeumont, which have an ordinary share capital of £800,000, report a gross surplus of £77,000 for 1910, as compared with £71,000 in the preceding year. After allocating the sum of £20,000 to depreciation, the accounts show net profits of £54,000, as against £45,000 in 1909, the dividend for 1910 being at the rate of 5·6 per cent. The report of the directors states that the total turnover effected by the workshops, foundries and cable factory, rose from £387,000 in 1909 to over £480,000 last year, and the orders booked down to the end of April, 1911, represented £200,000 in excess of the corresponding period in 1910. Four alternators of from 12,000 to 15,000 KW. were at present under construction in the company's shops, whilst the development of central stations and the increasing advantage taken of systems of distribution had caused a recrudescence of the demand for motors of low and average powers, and a special shop for the manufacture of these types was being erected. It had been decided to augment the iron and bronze foundries by the addition of a foundry for steel castings, and two furnaces would be erected for the production of open hearth steel and one electric furnace for the output of electric steel. The cable factory was well supplied with work, notwithstanding the very keen rivalry in this branch, and a copper wire drawing mill was to be erected in order that the company might be better able to meet the competition. It is added that the company has disposed of its gas and electricity supply works in return for shares in the Société Electricité et Gaz du Nord, which has been formed with a capital of £1,000,000 by the former company in association with the Société Parisienne pour l'Industrie des Chemins de Fers et des Tramways Electriques and the Compagnie Générale de Railways et d'Electricité.

Diesel Engine Co., Ltd.

THE eleventh ordinary general meeting was held on June 15th at the Cannon Street Hotel, E.C., under the chairmanship of Mr. C. C. Ellis.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 933), the CHAIRMAN said he did not propose to go into the accounts in any great detail, for they were simple. He could not help sympathising with the ordinary shareholders—of which he was one—on not having had a dividend for some time, but he was perfectly certain that none wanted to spoil the ship for a ha'porth of tar, and if they gave away their money now, when it was badly wanted for extensions and developments, they would probably regret it. He was perfectly certain that the money would bear fruit. The developments in the past year had cost them a considerable sum of money, but they were not finished and would probably cost a good deal more before they were done. There was about £1,100 more expense, due almost entirely to the increase in the drawing office staff. Their business had increased chiefly in that direction, and they were making drawings for new marine engines. Directors' fees, advertising and interest were considerably less, and almost balanced the increase in the establishment charges. Owing to the larger number of engines they had for delivery at the beginning of the year, they had to carry forward £5,000 for erection expenses, instead of £2,500, as in the previous year. Their marine engines had been taken up by some large shipbuilding firms both on the Continent and in their own country, and although there were other makers of the engine, the one they were interested in was generally considered to be the best. It was considered advisable by the board to interest some of the eminent British manufacturers of engines and also shipbuilders in the construction of this engine, and they were doing this on the basis of royalty. The demand for the marine engine was likely to be very large, as the possibilities of its superseding steam seemed to get more favourable almost every day. It enabled ships to carry more cargo, as the bulk which the oil took up was about a third of that which was taken up by coal, and ships could run longer distances without hampering themselves, and if they were trading in markets where there was oil, they could buy at the cheapest rates. They were at present making a 150-H.P. engine for a fishing trawler for an Aberdeen firm, and they hoped that would be the forerunner of considerable business. The undelivered orders amounted to about 7,200 H.P., as against half that amount in the previous year. The financial position was quite strong. In a business like theirs, they did not, of course, take their profits until the engines had been delivered, and consequently they had suffered during the past year through having carried forward fewer orders, owing to the bad trade experienced for the past two or three years. Trade, however, seemed to be improving very considerably, and they were now getting as many orders as they could execute. Since March 31st they had received a large number of orders for stationary engines, as well as for marine engines, and had supplied two engines, one of 200 H.P., and the other of 120 H.P., to the Canadian Government, for lighting their pavilion at the Crystal Palace. The chairman proceeded to quote from the speech of Sir Marcus Samuel, of the Shell Transport Co., with regard to the supply of liquid fuel, which he said would do away with one of their difficulties in the past, as, especially in India, they had been constantly asked what guarantee they could give as to a supply of oil being available.

MR. S. WHITMAN seconded the motion.

MR. LOWRY asked why Mr. Diesel had left the board; who were the shipbuilding firms manufacturing their engines; what was the cash consideration for the licences; did the directors contemplate manufacturing for themselves; and what the total orders in horsepower amounted to since March 31st.

The CHAIRMAN said Mr. Diesel had for years only had a small holding in the company, and being in Germany he could not often get to their meetings. Mr. Diesel was interested in many things, and accordingly he had sold his holding and retired from the board, but their relations were quite friendly. The chairman read a letter received from Mr. Diesel to show the existing friendly relations.

MR. LOWRY: Is it a fact that Mr. Diesel is trying to get other people to build engines here in opposition to you?

The CHAIRMAN said that was certainly not so. With regard to the licences, it was a question that he did not think it right to answer.

MR. LOWRY said it would be a big advertisement for them.

MR. CLARK pointed out that this was the only opportunity the shareholders had of knowing anything about the business, and there was nothing in the report.

The CHAIRMAN said they worked for the Government, and the very essence of their business was secrecy. If they were to give these things away they might as well throw the business up.

MR. CLARK said he had lately seen the engine producing electric light steadily for months at a cost of ½d. per unit. Living amongst electrical experts and engineers and buyers and sellers of engines, he found that nothing was really known of the Diesel engine. It was an engine which, were its merits known, would be wanted all over the world. However good a thing might be, they could not sell it without sticking a bill in the window, and he was convinced that if the company had only a small fraction of the energy which had been put into the sale of the Encyclopædia Britannica it would be in a very different position to-day.

The CHAIRMAN denied *in toto* that there was any lack of energy in the business. They had engines all over the world, but the whole of the engineering trade for the last two years had been bad. Now it was booming they did not make a Diesel engine in a day, and they would not see those now being made for nine months.

MR. CLARK said his point was whether the company was doing its best to bring the merits of the engine before probable buyers.

The CHAIRMAN said they had sold five engines already since March 31st, amounting to 1,655 H.P., and they certainly left no stone unturned; but he admitted that there was difficulty in inducing people to buy an engine which cost half as much again as a steam engine. It took some time to induce people to do this. But they had engines in London and Birmingham and nearly all over England. They had orders now for the Barking U.D.C., the Reigate U.D.C., the Leek U.D.C. and others, and if the shareholders lacked confidence in the board they had better say so, and he was out of it at once. As to whether they built their own engines, that largely depended on the shareholders; but there was something at the back of his mind when he said they were not paying a dividend. They would be absolutely helpless if they spent all their money. They had an arrangement for manufacturing engines in this country, and it was a very good one.

The report was then adopted.

British Electric Traction Co., Ltd.

SIR CHARLES RIVERS WILSON presided on June 15th at the Holborn Restaurant, W.C., over the fifteenth ordinary general meeting of this company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 971), the CHAIRMAN said that as that was the last occasion on which he would preside over the company's meeting, he wished to make a short retrospect of their history during that period. It was 16 years since the company entered upon its career with the view of affording a public service which at that time was very little known in this country. Electric traction by the overhead system had been fully established in America for 10 years previously, and to a lesser extent on the Continent of Europe, but so little was known of the overhead system of electric tramways in this country, that a good deal of the work of the company in the early years was devoted to removing the general objections which were raised by local authorities and others to the adoption of the overhead system. To-day, however, practically every tramway in this country was worked electrically. In the early years of the company, in addressing shareholders at their general meetings, he referred with confidence to the profitable and satisfactory career which they anticipated. At subsequent meetings he had to give expression from time to time to feelings of disappointment that their expectations had not been realised, but upon none of these occasions did he express despondency. This had been the attitude of everyone connected with the company. The directors believed that when the promotion and construction period came to an end the dividends on their capital could be maintained out of the profits of working the undertaking; but when they entered upon the period of working, as distinguished from the period of construction, they found that the local authorities who had by that time entered upon the business had reduced the fares and had given other concessions to the travelling public, and the wages of the men had been increased, so that the margin between the expenses and the receipts was very much smaller on electric tramways than had been originally estimated on the basis of the experience gained in other countries. In fact, the business had ceased to be an ordinary business, for a large and disturbing element of local politics had been introduced. If it were possible to increase the average fare per passenger by only a small fraction of a penny, they could earn sufficient profits, notwithstanding the higher wages and all the other disadvantages to which he had referred, out of the working of their undertakings, and to pay a very handsome dividend on the ordinary capital of the company. He believed an impression existed that the reason they were not paying the same dividends as in former years was entirely due to the fact that there was not now the same scope for promoting, financing and carrying out the construction work in connection with new schemes, but this was true only to a certain extent, the main reason why they were not now paying larger dividends was that the considerable investments which they had in the associated companies were not adequately remunerative. The average return on all their investments standing in the books at over 5 million pounds was only 2·7 per cent., and as they were paying 5 per cent. on their first debentures, and 4½ per cent. on the second, it was obvious that the balance was inadequate to meet the claims of the shareholders. If they had been able to get the same fares and carry on their tramways in the way they expected when the business was started, they would now be paying on their larger capital even higher dividends than those they were formerly paying on their smaller capital. The theory on which those expectations was founded was that a certain number of years were required in order to promote and construct the undertakings. During the first period the capital would be small but increasing, and they relied upon being able to pay dividends on the capital during the construction period out of the profits made by promotions, finance and constructions, and that afterwards when the promotions fell off they would be able to pay at least the same dividends out of the profits made by the associated companies in working the undertakings, and it was in the latter respect that they had been disappointed. Fares had been unduly reduced, concessions to the public had been beyond what was expected, wages had been increased, and, in short, the profits of working the tramways were less than they expected they would be, and less than they were in other countries where the conditions were more favourable. He was glad to point to a marked improvement in the associated companies which had taken place

during the past year. Altogether, the various companies in which they were interested had earned something like £100,000 more than during the previous year, but they had become cautious in their adversity, and had put larger amounts to the reserve fund, and only in a very few instances made small increases in the dividend. The amount they had placed to reserve during the past year aggregated £221,438. Of course, in considering the matter, it must be borne in mind that the amount of the dividend this company received from the associated companies had been earned by a few of the principal companies. The smaller companies had also made satisfactory progress, but the increase in their case was not sufficient to admit of increased dividend. He was glad to say that the improvement which took place last year was being fully maintained during the present year; the conditions of trade appeared to be better, and the weather conditions had also been favourable. It was reasonable to hope, therefore, that the results of the current year would be still further improved. They had effected a reduction in sundry debtors and debit balances of £200,000. The investments had increased from just under £5,000,000 to £5,240,000, and the average return on the smaller volumes of investments was greater than the average return on the smaller volume of investments in the preceding year. The directors had under their consideration a scheme for dealing with the question of the arrears of dividends upon the preference shares and the question of the reserve funds in relation to depreciation of assets, which would be submitted to the shareholders at an early date. What the directors proposed was a rearrangement and not a reduction of capital, so as to adjust equitably the relations between the two classes of shareholders, in order to stop the arrears of cumulative preference dividend which at present debarred the ordinary shareholder from any early expectation of a dividend. The directors did not despair of being able to put before the shareholders an equitable scheme acceptable to both classes of shareholders. He believed that now the clouds were passing by and that they might look forward with confidence to a successful future for the company under the able administration of Mr. Garcke.

MR. EMIL GARCKE seconded the motion.

Considerable discussion ensued, and MR. SOAMES proposed that a committee of shareholders be appointed to confer with the board on the position of the company and report to a future meeting. This was seconded by MR. LUMLEY SMITH.

The CHAIRMAN urged that it would be very inexpedient to appoint a committee in view of the proposals they were contemplating, and Mr. SOAMES agreed to his motion being put as a separate resolution.—The report was then agreed to.

MR. RAWORTH was re-elected a director, but on the motion to re-elect Sir Charles Freemantle as a director being put to the meeting, it was lost by a show of hands. A poll was then demanded, and subsequently taken, when the motion was carried by 6,047 votes to 2,832, exclusive of any proxies deposited with the board.

The motion of MR. SOAMES to appoint a Committee was also carried on a show of hands, but was subsequently defeated on a poll by 6,047 votes to 2,982.

United Electric Tramways of Monte Video, Ltd.

MR. GEO. A. TOUCHE (chairman) presided at Winchester House, Old Broad Street, E.C., on June 16th, over the seventh annual meeting of the above company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 931), the CHAIRMAN first referred, at considerable length, to the strike which had occurred in Monte Video in May, which was after the close of the accounts under review. His object was to direct the attention of those interested in Uruguay not to the immediate effect on companies directly concerned, but generally to a tendency of what it would be prudent for the investors of the present, and the prospective investor, to take note. One of the financial papers had dealt with the matter, and a sentence might be quoted as giving expression to the very general view. It said that, although the strike was ostensibly a matter of wages and terms of employment, yet the struggle was in reality of a political nature, recent changes in the Administration having led to the belief that the strikers would have the sympathy of the authorities. From private communications they received they had been expecting some labour troubles, but not so soon as they broke out. However, agitators stirred their men up, and the terms demanded were onerous and impossible. The company offered certain concessions, and these were accepted; but their men went out on strike a second time, apparently with no justification except the false rumours, which appeared to have been spread by persons who were interested in the strike continuing. Whilst they desired to improve the conditions of those whom they employed, there were certain fundamental rights which should not be surrendered. The first was the right to deal directly with their employés without outside interference, and the second, the right of the employer to have the same freedom to employ or discharge a man, as a man had to engage or discharge himself from employment. As a result of the negotiations a general strike followed, and the city was practically under martial law. At the commencement the Government assured the company that proper protection would be given them, but they then adopted an attitude which was not expected, and threatened them with heavy fines for not offering the public an adequate service. Many of the best men in their employ were willing to work, but those who did work were molested, and as the result it was decided to suspend the service rather than imperil the safety of their loyal employés. It would, of course, have been easy to purchase peace by yielding, but when fares were restricted under the terms of a concession, there was a point beyond which wages could not be forced without making them higher than the earnings would afford. This was what the men did not understand, and it was at the root of a great many disputes. After a general strike was declared, public opinion was aroused, and the Government came to the support of the men willing to work, and ultimately the company's terms were accepted, and work was resumed. The chairman proceeded to deal with the attitude of the Government in the matter, and as to its effect on the development of the country, and said he refused to believe that a responsible Government would deliberately put back the hands of the clock. They did not take a pessimistic view of the situation, and were sure the distinguished President and his advisers would fully realise the importance of supporting confidence not only between themselves and the investing public, but also between employer and employed. The effect of the strike on their traffics was that the total receipts for May were £16,317, as against £22,178 in May of last year. The net receipts were £6,565, as compared with £9,735, a difference of £3,170. The real effect of the strike would, however, be represented by the addition to the permanent charges of the company. With regard to the balance-sheet there was not much variation in the figures. They had issued a further £100,000 of debenture stock during the year. On the other side they would see an increase of £82,201 in the property account. Nearly a third of this expenditure was accounted for by the extension of the power house, car-shed, store sheds, and equipment. Other expenditure was chiefly represented by the extension of their hotel at Pocitos, and the preliminary expenses of the line to Maldonado. As regarded maintenence, they had to report again that the tracks, feeders, cars, and other equipment were all in good condition and well maintained. Naturally, the cost of maintenance must be expected to increase from year to year. The results for the financial year which closed on October 31st, 1910, were again satisfactory. This was the first time they had been able to make a comparison of one complete year under electric traction with another, and when this was considered, the result was most pleasant, and indicated that the development of the city resulted largely from the quicker means of transit afforded by the tramways. The weather conditions had also been favourable, and another important factor was the better arrangements arising from the gradual perfecting of the organisation and improvements in handling traffic, although they made no claim that the final goal had been reached. The traffic receipts were £279,990 compared with £253,257 in the previous year—an increase of £26,733 or 10½ per cent. There was a large increase over the year 1908-9, when the lines were partly electrified. The passengers carried were 32,447,355, against 29,293,806, an increase of 3,180,551, or over 10½ per cent. This meant that the population of the city was carried 108 times over in the year, against 95 times in the previous year. It had to be remembered that they were only one of two large systems operating in Monte Video, and the two together carried the population 195 times over. This result was arrived at by running 96,503 less car-miles. The working expenses were 55·62 per cent., a decrease of 2·73 per cent., and that, in spite of the increased cost of maintenance and the increased cost of coal. The net receipts amounted to £124,247, an increase of £18,775, or nearly 18 per cent. over the net receipts of the previous year. The increase over the last complete year of animal working was 265 per cent. If they took the first six months of the present financial year ending April 30th, the gross receipts were £166,176, compared with £150,195 for the six months ending April 30th, 1910, or an increase of £15,981. Compared with the six months of the year before that the increase was £28,194, or about 20½ per cent. The working expenses of the six months ending April 30th were 51·17 per cent., against 52·37 per cent. in the corresponding period; whilst the net receipts were £81,143 against £71,536, an increase of £9,607, or 13·43 per cent. Taking seven months of the current financial year which included the period of the strike, the increase for the seven months amounted to £6,437. Although the results all along had proved the board's expectations, they still looked for better traffic and reduced working expenses in the current year, although he spoke with some qualification, because the terms they had made with their employés involved them in greater charges. Altogether the credit balance with the amount brought forward came to £88,101, and it was recommended to transfer £20,000 to the renewal and contingency account, carry £13,754 forward, and pay a dividend on the ordinary shares, which would make 7 per cent. for the year, as against 6 per cent. for the previous year. In conclusion, the chairman quoted reports showing the rapid development of Monte Video, which should, he said, be of benefit to the company in the future.

MR. T. FRAME THOMSON seconded the motion, and the report was adopted without discussion.

R. Waygood & Co., Ltd.—Mr. H. C. Walker presided on 16th inst. at the meeting of this company held at Cannon Street Hotel, E.C. He said that the sales for the year were considerably in excess of any previous year. The profit on trading was £66,260, and the dividends on investments £2,208. The amount available was £11,495. An interim dividend of 5 per cent. had been paid, and a further dividend of 7 per cent. per annum for the six months ended March, 1911, was recommended, making 6 per cent. for the year; £3,395 is carried forward. Messrs. Harland & Wolff entrusted them with the contract for fitting in the *Olympic* and *Titanic* eight electric passenger lifts and eight other electric lifts. Messrs. Harmsworth and H. C. Walker, jun., who have been many years in the company's service, have been elected directors.

MARKET QUOTATIONS.

Monday, June 19th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	"	28/-	..
a " Sulphuric	"	5/8	..
a Ammoniac, Sal	"	42/-	..
a Ammonia, Muriate (crystal)	per ton	£29	..
a "	"	£30	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£16	..
a Ferro-Silicon (50 %)	"	£12 10	..
a Copper Sulphate	"	£23	..
a Lead, Nitrate	"	£24	..
a " White Sugar	"	£22 15	..
a " Peroxide	"	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, n casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a " Chlorate	per lb.	8½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide	"	7d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	"	£6 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5 5	..
a Soda, Caustic (white 70 %)	"	£11	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a " Cyanide (basis 100 %)	"	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£70	..
b " Wire, in ton lots	"	£102	..
b " Sheet, in ton lots	"	£120	..
p Babbitt's metal ingots	"	£35 to £145	..
c Brass (rolled metal 2" to 12" basis	per lb.	6¾d.	¼d. inc.
c " Tube (brazed)	"	8¼d.	..
c " (solid drawn)	"	7d.	..
c " Wire, basis	"	6¾d.	..
c Copper Tubes (brazed)	"	9d.	..
c " (solid drawn	"	8¾d.	..
g " Bars (best selected)	per ton	£71	£1 inc.
g " Sheet	"	£71	£1 inc.
g " Rod	"	£71	£1 inc.
c " (Electrolytic) Bars	"	£69	£1 10 inc.
c " " Sheets	"	£74	5/- inc.
c " " Rod	"	£62 10	£1 10 inc.
c " " H.C. Wire	per lb.	7¾d.	¼d. inc.
f Ebonite Rod	"	5/8	..
f " Sheet	"	4/9	..
n German Silver Wire	"	1/11	..
h Gutta-percha, fine	"	8/6	..
h India-rubber, Para fine	"	4/1	8d. dec.
i Iron Pig (Cleveland warrants)	per ton	46/9	6d. inc.
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Ingot	"	£18 10 to £13 15	5/- inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8 10 to £8 15	5/- inc.
d Mica (in original cases) small	per lb.	6d. to 2s.	..
d " " " medium	"	2/6 to 4/-	..
d " " " large	"	4/6 to 8/6	..
p Phosphor Bronze, plain castings	"	11d.	..
p " " rolled bars & rods	"	1/0½	..
p " " rolled strip & sheet	"	1/1	..
o Platinum	per oz.	172/6	6/- inc.
e Silicium Bronze Wire	per lb.	3¾d.	¼d. inc.
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£189 to £190	£15 dec.
p " Wire, Nos. 1 to 16	per lb.	2/5	1d. inc.
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh's (Vieille Montagne bnd.)	"	£29 10	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Stock Exchange Notice.—Application has been made to the Stock Exchange Committee to allow the following securities to be quoted in the Official List:—Underground Electric Railways Co. of London, Ltd.—500,000 shares of £10 each, fully paid (special application).

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.—The half-yearly meeting is to be held on Tuesday next at 106, Cannon Street, E.C., for the purpose of sanctioning the payment on July 1st of a dividend of 5s. per share, less income-tax, on the preference shares for the half-year, at the rate of 5 per cent. per annum. The board decided not to pay on this occasion an interim dividend on the ordinary shares. In the circular issued announcing this decision it was stated:—"The unstable condition of the market for raw material since October 1st last leads your directors to think it wiser to wait until the end of the financial year, when they will have before them the result of the year's trading, before recommending a distribution of profits to the ordinary shareholders."

STOCKS AND SHARES.

Saturday Morning.

With the Coronation holidays so near at hand, the Able Editor demands copy days in advance of the regular time, and this is the apology for writing what, after all, can be but a bald and brief recital of the markets to which electricity appertains.

The feature of the week has been a strong revival in Home Railway stocks. When last we wrote, the position of that market was decidedly feeble, and all sorts of rumours were afloat as to the big houses being in difficulties in connection with the settlement which has just taken place. As usual, it was a case of much cry and little wool, and the account passed off without any trouble materialising. Thereupon prices underwent a swift recovery, in which nearly all classes joined. The rise has helped Metropolitan and District, but there has been a slight decline in Central London Ordinary. All the Tubes, of course, ought to do very well out of the additional traffic, especially as the police regulations admit of the companies running as late as it is safe for them to do so.

The British Electric Traction meeting on Thursday last brought out some acid criticism of the board, and the directors were told home truths which it now seems a great pity were not realised more fully years ago. However, it is no use "jobbing backwards," as the Stock Exchange says, and now it is to be hoped that the board will produce a really sound scheme for putting the company upon a good basis. The work of capital reduction, distasteful as it must necessarily be, ought to be faced in a bold spirit which will not fear to produce a drastic scheme for the reorganisation of the capital; and unless this is done, it seems to us that the work will only have to be undertaken all over again at some later date. Judging from the speeches made at the meeting, it is not apparent that the directors recognise the absolute necessity for this; but, perhaps, the shareholders' criticisms will bring home to them the fact that in grasping the nettle fearlessly, they will be supported by a strong body of the proprietors who are in earnest about the cutting down of the capital so as to bring it into true relation with the assets of the undertaking.

Electricity Supply shares are just as dull as ever, and the illuminations have had no effect whatever upon the market. The Stock Exchange, it may be observed, will not, after all, draw its current from its own installation, but the power is to be supplied by the City Company for a scheme of illumination which should rank worthily with that adopted by the other prominent places in the vicinity of the Bank of England, which itself towers above all the others in the lavish splendour of its preparations for the great event.

Foreign tramway and power issues are chiefly noticeable for the recovery of their dividend by Sao Paulo Trams, with a further ¾, making a gain of 3¼ altogether. The Mexican group is mildly steady. One or two small losses followed upon the rumour that to earthquake and rebellion, plague had succeeded in Mexico. Somebody said it was a plague of bears, and he may not have missed the truth by much. Rio Tramway shares are a lively market, without quotable change in price, whereas the company's bond issues are both lower.

Manufacturing shares keep very steady. A nominal 10s. fall in Callender's Ordinary is represented exactly by the dividend and bonus which the price is now *ex*.

National Telephone Deferred fell 3 points on liquidation by weak holders. Reuters continue to creep up quietly; no doubt Coronation traffic prospects are attracting attention to them. Marconi's have become the centre of an eager gamble. The price touched 41s. before going back to 38s. 9d., at which it shows a small loss on the week. Eastern descriptions are heavy. A few prior-charge stocks have improved, the rises not exceeding ½ in any case.

Metalite, Ltd.—According to a statement appearing in the *Financial News* on June 15th, a meeting of the board of Metalite, Ltd., was held on Tuesday last week, at which "the following gentlemen were co-opted to the board and took their seats, the first-named as chairman:—The Hon. Sir Cornthwaite H. Rason, Kt., ex-Premier West Australia and director of the Bovril Australian Estates, Ltd.; Mr. Walter Bernard Hopkins, director of A. Darracq and Co., Ltd.; Mr. William Stewart, 42, Frederick Street, Edinburgh."

Change of Address.—The National Electric Construction Co., Ltd., has removed to 3, Laurence Pountney Hill, Cannon Street, E.C. This notice also applies to its various subsidiary companies.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations June 16th.	Rise + or Fall —	Present Yield p.c.
	*					£ s. d.
Bournemouth & Poole, Ord.	10	5½	5½	8 — 9	..	6 2 3
Do. 4½ % Pref.	10	4½	4½	9 — 10	..	4 10 0
Do. Second 6 % Pref.	10	6	6	10⅝ — 10⅞	..	5 12 11
Do. 4½ % Deb. Stock	Stock	4½	4½	102 —104	..	4 6 7
Brompton & Kensington, Ord.	5	10	10	7⅞ — 8¼	..	6 1 3
Do. 7 % Cum. Pref.	5	7	7	7½ — 8	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City	5	5	5	3⅞ — 4⅛	..	5 14 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 12 4
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅞ — 4⅛	..	5 2 10
Do. Do. 4 % Deb.	100	4	4	94 — 96 xd	—2	4 3 4
Chelsea, Ord.	5	4½	5	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	100 —102	..	4 8 3
City of London, Ord.	10	7	7	11¾ — 12½	..	5 14 3
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 12 4
Do. 5 % Deb.	Stock	5	5	121 —125	..	4 0 0
Do. 4½ % Second Deb.	100	4½	4½	101 —104	..	4 0 0
County of Durham, 5 % First Mort. Deb.	Stock	5	5	92 — 94	..	5 6 5
County of London, Ord.	10	5	5	7⅝ — 8⅛	..	6 3 1
Do. 6 % Pref.	10	6	6	10⅞ — 11⅛	..	5 7 5
Do. 4½ % Deb.	Stock	4½	4½	109 —111	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	99 —102	..	4 8 3
Edmundson's, Ord.	5	Nil	Nil	2/16 — 3/16	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2⅛ — 3	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	86 — 89	..	5 1 2
Folkestone	5	5½	6	4⅛ — 4⅜	..	6 9 9
Do. 5 % Cum. Pref.	5	5	5	4⅜ — 5¼	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	97 —100	..	4 10 0
Hove	5	8½	9½	6¾ — 7¼	..	6 11 0
Kensington & Knightsbridge, Ord	5	8	9	7 — 7⅞	..	6 2 0
Do. 4 % Deb.	Stock	4	4	93 — 95	..	4 4 3
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	2	1⅜ — 2⅛	..	2 16 5
Do. 6 % Pref.	5	6	6	4⅜ — 5⅛	..	5 17 1
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92 xd	—2	4 7 0
Metropolitan	5	5	5	3⅜ — 3⅞	— ⅛	6 9 0
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4¼	..	4 16 0
Do. 4½ % First Mort. Deb.	Stock	4½	4½	101 —104	..	4 6 7
Do. 3½ % Mort. Deb.	Stock	3½	3½	86 — 89	..	3 18 8
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	98 —100	..	4 10 0
Newcastle-on-Tyne	5	4	4	3⅞ — 4⅛	..	4 14 2
Do. 5 % Pref., Non. Cum.	5	5	5	4 — 4⅛	..	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	99 —102	..	4 18 0
Notting Hill	10	7½	8	12 — 12⅜	..	6 5 6
Oxford	5	7	7½	6⅜ — 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10	8⅞ — 9¼	..	5 8 1
Do. 7 % Pref.	5	7	7	6⅜ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	86 — 88	..	3 19 7
Smithfield Markets, Ord.	5	Nil	Nil	1⅜ — 1⅞	..	Nil
South London, Ord.	4	5	5	3 — 3¼	..	6 3 1
Do. 5 % First Mort. Deb.	100	5	5	101 —104	..	4 16 2
South Metropolitan, 7 % Pref.	1	7	7	1⅛ — 1¼	..	5 12 0
Do. 4½ % First Deb. Stock	100	4½	4½	97 —100	..	4 10 0
Urban, Ord.	5	5	3½	⅛ — 1	..	18 15 0
Do. 5 % Cum. Pref.	5	5	3½	2⅛ — 3	..	6 5 5
Do. 4½ % First Mort. Deb.	100	4½	4½	87 — 89	..	5 1 2
Westminster, Ord.	5	10	10	7⅞ — 8¼	..	5 14 3
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅛	..	4 3 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Calcutta, Ord.	5	8	8½	6⅝ — 7¼	..	5 19 4
Do. 5 % Pref.	5	5	5	4⅞ — 5⅜	..	4 13 0
Calgary Power, 1st Mort. Bds.	100	5	5	96 — 98	..	5 2 0
Canadian Gen. El. Com.	$100	6	6	106 —109 xd	—2	5 10 1
Do. 7 % Pref.	$100	7	7	121 —124	..	5 12 11
Cordoba Lt., Power and T., Ord.	1	..	6	1/32 — 1/16	..	6 8 0
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	..	6	95 — 97 xd	—2½	6 3 9
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	87 — 90	..	5 11 1
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	83 — 85	..	5 17 8
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	Nil	1/16 — 3/32	..	..
Do. 6 % Pref.	1	6	6	13/16 — 7/8	..	8 6 8
Kaministiquia Power, 5% G. Bs.	$500	5	5	103½ —105½ xd	..	4 14 9
Madras, Ord.	5	Nil	Nil	3 — 3½	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	91½ — 93½ xd	—2½	5 6 11
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	88 — 90	..	5 11 1
Mexican Lt. & Power, Common	$100	4	4†	82½ — 84½	..	4 14 8
Do. 7 % Cum. Pref.	$100	7	7	106 —108	..	6 9 8
Do. 5 % 1st Mort. Gold Bds.	..	5	5	94 — 95	— ¼	5 5 3
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	89½ — 91½	..	5 9 3
Montreal, Lt., H. and Power	$100	..	8	163 —166	—1	4 16 5
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	63 — 65	..	7 13 10
River Plate, Ord.	Stock	9	10	218 —228	..	4 7 9
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	104 —106	..	4 15 3
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	5	5	115 —118	..	4 4 9
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	109 —111	..	4 10 1
Do. 4½ % Per. Deb.	Stock	4½	4½	103 —105	+1	4 5 9
Toronto Power, 4½ % Deb.	Do.	4½	4½	99 —101 xd	—2	4 9 1
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	93 — 95	..	5 5 3
Victoria Falls Power, Pref.	1	Nil	Nil	31/32 — 1 1/32	..	Nil
Do. (new)	1	..	Nil	1/16 — 1/8	..	Nil
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	..	6	108 —110	..	5 9 1

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	Nil	7⅜ — 7⅞	..	Nil.
Do. 5 % Deb. Red.	Stock	5	5	100 —102	+ ½	4 18 0
American Telep. & Teleg., Cap.	$100	8	8	156 —158	..	5 1 3
Do. Collat. Trust	$1000	4	4	96 — 98	..	4 1 8
Anglo-American Telegraph	Stock	3⅜	3⅜	69 — 71	..	5 5 3
Do. 6 % Pref.	Do.	6	6	113 —114	..	5 5 3
Do. Def.	Do.	25/-	30/-	26⅜ — 26⅞	..	5 11 7
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101 —103	..	4 17 1
Chili Telephone	5	8	6†	7 7/16 — 7 5/8	..	5 11 11
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	88½ — 90½	+ ½	4 8 5
Cuba Telegraph	10	6	6	10 — 10⅜	+ ⅛	5 11 7
Do. 10 % Pref.	10	10	10	17¼ — 18¼	..	5 9 7
Direct Spanish Telegraph, Ord.	5	4	4	3⅞ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	8⅜ — 8⅝	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	101 —103	..	4 7 5
Direct United States Cable	10	4	5	7½ — 8	..	6 5 0
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	100 —102	..	4 9 1
Eastern Telegraph, Ord. Stock	Stock	7	7	136 —139	—1	5 0 9
Do. 3½ % Pref. Stock	Do.	3½	3½	84 — 86	..	4 1 5
Do. 4 % Mort. Deb.	Do.	4	4	101 —103	..	3 17 8
Eastern Extension	10	7	7	13½ — 13⅝	— ¼	5 1 10
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 17 8
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	99½ —101½	..	3 18 10
Globe Telegraph and Trust	10	5⅞	5⅞	11¼ — 11⅜	..	5 0 0
Do. 6 % Pref.	10	6	6	13⅜ — 13⅝	..	4 8 1
Great Northern Telegraph	10	18	18	31½ — 32½	..	5 10 9
Indo-European Telegraph	25	13	13	56½ — 58½	..	5 11 1
Mackay Companies Common	$100	4¼	5	92 — 94 xd	—1½	5 6 5
Do. 4 % Cum. Pref.	$100	4	4	75 — 77 xd	—3	5 3 11
Marconi's Wireless Telegraph	1	Nil	Nil	1⅞ — 2	— 3/32	Nil.
Monte Video Telephone, Ord.	1	6	6	⅞ — 1	..	6 0 0
Do. 5 % Pref.	1	5	5	¾ — ⅞	..	5 10 4
National Telephone, Pref.	Stock	6	6	104½ —105½	..	5 14 0
Do. Def.	Do.	6	6	124 —126	—3	4 15 3
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5⅛ — 5⅜	..	4 6 11
Do. 3½ % Deb.	Stock	3½	3½	99½ —101½	+ ½	3 9 0
Do. 4 % Deb.	Do	4	4	99½ —101½	+ ½	3 18 10
New York Telep., 4½% Gen. Bnds.	100	4½	4½	100 —101	..	4 9 1
Oriental Telep. and Elec.	1	8	6†	1⅜ — 1 11/16	..	4 8 3
Do. 6 % Cum. Pref.	1	6	6	1⅛ — 1⅜	..	4 16 0
Do. 4 % Red. Deb.	Stock	4	4	87⅞ — 89⅞	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	100½ —102½	+ ½	3 18 1
Reuter's	8	5	5	8¼ — 8⅞	+ ½	4 11 5
Submarine Cables Trust	Cert.	6	6	131 —134	..	4 9 7
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	100 —102	..	4 8 3
United River Plate Telephone	5	8	6†	7⅜ — 7 13/16	..	5 2 5
Do. 5 % Cum. Pref.	5	5	5	5⅜ — 5⅝	..	4 8 11
West Coast of America	2½	2½	2½	1⅜ — 1⅝	..	6 5 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	99½ —101½	..	3 18 10
West India and Panama Teleg.	10	Nil	2	2⅜ — 2⅝	..	7 12 5
Do. 6 % Cum. 1st Pref.	10	6	6	10⅛ — 10⅜	+ ⅛	5 11 7
Do. 6 % Cum. 2nd Pref.	10	14½	6	9⅝ — 10	+ ⅛	6 0 0
Do. 5 % Debs.	100	5	5	102 —104	..	4 16 2
Western Telegraph, Ltd.	10	7	7	13½ — 14 xd	— ¼	5 0 0
Do. 4 % Deb.	Stock	4	4	101 —103	..	3 18 10
Western Union Tel., 4% Bnds. A	$1000	4	4	105 —108	..	3 14 1
Do. 4½ % Fdg. Bonds	$1000	4½	4½	99½ —102½	..	4 7 10

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations June 16th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	3/16 — 5/16	..	Nil
Do. 5 % Pref.	1	5	5	7/8 — 1	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 5
Brit. Elec. Trac., Ord.	10	Nil	Nil	1/16 — 1/8	..	Nil
Do. 6 % Pref.	10	3	..	3/4 — 4 1/16	— 1/8	..
Do. 5 % Deb.	100	5	5	96 — 99	..	5 1 0
Do. 4½ % 2nd Deb.	100	4½	4½	76 — 81	+1	5 11 1
Central London Railway, Ord.	100	3	3	71 — 73	—1	4 2 2
Do. Pref.	100	4	4	87 — 89	..	4 9 11
Do. Def.	100	2	2	62 — 64	..	3 2 6
Do. 4 % Deb.	100	4	4	104 —106	..	3 15 6
City & South London, Ord.	100	1½	1½	31½ — 32½	—1	4 12 4
Do. 5 % Pref., 1891	100	5	5	109 —111	..	4 10 1
Do. Do. 1896	100	5	5	105 —108	+1½	4 12 7
Do. Do. 1901	100	5	5	104 —107	+1	4 13 6
Do. Do. 1908	100	5	5	103 —106	..	4 14 4
Do. 4 % Deb.	100	4	4	102 —104	+1	3 16 7
Dublin United Trams, 6 % Pref.	10	6	6	12½ — 13½	..	4 10 7
Great Northern & City, Pr'f. Ord	10	Nil	Nil	1/16 — 1/8	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	Nil	1½ — 2	..	Nil
Do. 4½ % Deb.	100	4½	4½	75 — 80	..	5 12 6
Isle of Thanet Trams, 5 % Pref.	5	1½	2½	2½ — 2¾	..	4 10 11
Do. 4 % Deb.	100	4	4	79 — 84	..	4 15 3
Lancashire United, 5 % Deb.	100	5	5	82 — 84	..	5 19 1
London Elec. Railw'ys, 4 % Deb.	100	4	4	98 —100	..	4 0 0
London United Trams, 5 % Pref.	10	Nil	Nil	3/4 — 4/8	— 1/8	Nil
Do. 4 % Deb.	100	4	4	77 — 80	+1	5 0 0
Metropolitan Railway Consol.	100	1	1⅛	48¾ — 49½	+ ½	2 15 10
Do. Surplus Lands	100	2½	2½	68 — 70	..	3 18 7
Do. 3½ % Deb.	100	3½	3½	93 — 95	..	3 13 8
Do. 3½ % Pref.	100	3½	3½	90 — 92	..	3 16 1
Do. 3½ % Con. Pref.	100	3½	3½	89 — 91	..	3 16 11
Metropolitan District Ord.	100	Nil	Nil	30 — 30½	+ ½	Nil
Do. 6 % Deb.	100	6	6	148 —150	..	4 0 0
Do. 4 % Deb.	100	4	4	98 —100	..	4 0 0
Do. 4 % Prior Lien	100	4	4	102 —104	..	3 16 11
Do. 4½ % First Pref.	100	..	3½	89 — 91	..	3 11 5
Do. 3½ % Gtd.	100	3½	3½	76 — 78	+1	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5½	3/32 — 1 1/32	..	5 6 8
Do. Def.	1	Nil	Nil	1/32 — 1/16	..	Nil
Do. 5 % Pref.	1	5	5	3/32 — 1 1/32	..	4 17 0
Do. 4½ % Deb.	100	4½	4½	102½ —104½	..	4 6 2
Do. 5 % Deb.	100	5	5	102 —104	+1½	4 16 2
Potteries, Ord.	1	2	..	1/16 — 3/32	..	..
Do. 5 % Pref.	1	5	5	1/16 — 3/32	..	6 19 2
Do. 4½ % Deb.	100	4½	4½	88 — 91	+1	5 18 11
South Metro. Trams, 6 % Pref.	1	3	..	1/32 — 1/16	..	..
Do. 4 % Deb.	100	4	4	75 — 80	..	5 0 0
Underground Elec. Railways 5 % Prior Lien	..	5	5	100 —101	..	4 19 0
Do. 4½ % Bonds	100	4½	4½	100 —102	+1	4 8 3
Do. 6 % Income	100	Nil	10/-	67 — 69	..	0 14 6
Do. Power House Debs.	100	..	4	100 —102	..	3 18 5
Yorkshire (West Riding), Ord.	5	Nil	Nil	1/16 — 3/16	+ 3/16	Nil
Do. 6 % Pref.	5	Nil	Nil	2⅜ — 2¾	..	..
Do. 4½ % Deb.	100	4½	4½	84 — 87	..	5 3 6

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5	5½ — 5⅝ xd	..	4 13 0
Do. 2nd Pref.	5	5	5	4 15/16 — 5⅛ xd	— 1/16	4 16 5
Do. 4 % Deb.	100	4	4	94 — 96 xd	—2	4 3 4
Do. 4½ % Deb.	100	4½	4½	99½ —101½ xd	—1½	4 8 8
Do. 5 % Deb.	100	5	5	100½ —102½	..	4 15 3
Auckland Trams, 5 % Deb.	100	5	5	104½ —106½	..	4 13 11
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅞ — 11⅛	..	5 5 6
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brisbane Trams Invt., Ord.	5	8½	8†	6½ — 6⅝	..	6 5 11
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	101 —104	—1	4 6 7
B. Columbia Elec. Rly., Def.	100	8	8	145 —149	—1	5 7 5
Do. Pref. Ord.	100	6	6	127 —130	..	4 12 4
Do. 5 % Pref.	100	5	5	110 —112	..	4 9 3
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	102 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	101½ —103½	..	4 7 0
Calcutta Trams, Ord.	5	4½	5	5⅝ — 6⅛	+ ⅛	4 1 8
Do. 5 % Pref.	5	5	5	5⅛ — 5⅜	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	Nil	1/16 — 1/16	..	Nil
City Buenos Aires Trams (1904)	5	5	5	5⅛ — 5⅜	..	4 5 1
Do. 4 % Deb.	100	5	5	96 — 99	..	5 1 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 — 98	..	5 2 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100½ —102½	..	4 17 7
Kalgoorlie Elec. Trams	1	Nil	Nil	3/32 — 3/32	..	Nil
Do. 5 % A Deb.	100	5	5	91½ — 94½ xd	—2½	5 5 10
Do. 6 % B Deb.	100	6	5	63 — 67 xd	—3	7 9 3
La Plata Elec. Trms, Prf, 17/6 pd.	1	6*	6	13/16 — 15/16	..	6 8 0
Lisbon Elec. Trams, Ord.	1	6	6	1 — 1⅛	..	4 16 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	99 —103	+1	4 17 1
Madras Elec. Tr. (1904), Deb.	100	5	5	97 — 99	+1	5 1 0
Manaos Trams & Lt., 1st Deb.	100	..	5	94 — 97	..	5 3 1
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100 —102	..	4 18 0
Mexico Trams Com.	$100	6	7	123½ —125½	— ½	5 11 7
Do. Gen. Con. 5 % Bonds	..	5	5	94 — 96	— ½	5 4 2
Do. 6 % Bonds	100	6	6	100 —102	..	5 17 8
Para Elec. Rlys. & Lt., Ord.	5	..	10	7 — 7⅛	..	6 17 11
Do. 6 % Pref.	5	6	6	5⅞ — 6⅛	..	5 2 2
Do. 5 % 1st Deb.	100	5	5	99 —101	..	4 19 0
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	1 1/16 — 1 1/8	..	2 13 4
Do. 5 % 1st. Deb.	100	5	5	104 —106	..	4 14 4
Rangoon El. Tr. & Sup., Pref.	5	6	6	5½ — 5¾	..	5 4 4
Do. 4½ % 1st Deb.	100	4½	4½	99 —102	..	4 8 3
Rio de Janeiro Trams	$100	2	5	116 —117	..	4 5 6
Do. 1st Mort. 5 % Bonds	..	5	5	102⅜ —103⅜	— ¼	4 16 5
Do. 5 % Mort. Bonds	100	5	5	95¼ — 96¼	— ¼	5 3 11
Sao Paulo Tram, Lt. and P.	$100	10	10	185 —187 xd	+ ½	5 6 11
Do. 5 % 1st Deb.	$500	5	5	102 —104	..	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	82 — 86	..	5 16 3
Southern El. Tr. B.A., 5 % Deb.	..	5	5	97 — 99	..	5 1 0
Un. Elec. Trams Monte Video	5	7	6†	5⅜ — 6⅛	..	5 12 0
Do. 6 % Pref.	5	6	6	5 — 5½	..	4 10 11
Do. 5 % 1st Deb.	100	5	5	102 —105	..	4 15 3
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	106 —108	+ ½	4 3 4

MANUFACTURING COMPANIES.

Aron, Ord.	1	..	..	23/32 — 27/32	..	..
Do. 6 % Pref.	1	12	9	15/16 — 29/32	..	6 17 11
Babcock & Wilcox	1	24	20†	5⅜ — 5⅝	..	4 5 4
Do. Pref.	1	6	6	1⅜ — 1½	..	4 0 0
B.I. & Helsby Cables	5	10	10	6⅞ — 7⅛	..	6 15 7
Do. Pref.	5	6	6	6 — 6¼	..	4 12 4
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	96 — 99	..	4 10 11
British Westinghouse, Pref.	3	Nil	Nil	3/8 — 1/2	..	Nil
Do. Deb.	100	4	4	61 — 64	..	6 5 0
Do. 6 % Prior Lien	100	6	6	100 —103	..	5 16 6
Browett, Lindley, Ord.	1	Nil	Nil	3/32 — 1 1/16	..	Nil
Do. Pref.	1	Nil	Nil	14/16—15/16	..	Nil
Brush, Ord.	2	Nil	Nil	1/16 — 3/16	..	Nil
Do. 7 % Pref.	2	Nil	Nil	3/8 — 1/2	..	Nil
Do. 4½ % Deb.	100	4½	4½	59 — 64	..	7 0 8
Do. 4½ % Second Deb.	100	4½	4½	41 — 46	..	9 15 7
Callender's Cable	5	15	10†	8⅞ — 9⅜ xd	— ⅛	8 0 0
Do. Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. Deb	100	4½	4½	102 —104	..	4 6 7
Castner-Kellner	1	17½	*7½†	3⅛ — 3⅜	..	4 19 2
Do. Deb.	100	4½	4½	104 —107	+1	4 4 1
Crompton & Co.	3	Nil	Nil	1/8 — 3/8	..	Nil
Do. Deb.	100	5	5	60 — 70	..	7 2 10
Dick, Kerr	1	5	6	13/16 — 15/16	..	6 8 0
Do. Pref.	1	6	6	1 — 1⅛	..	5 6 8
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £3 paid	5	Nil	Nil	1/16 — 1/8	..	Nil
Do. fully paid	5	Nil	Nil	1/16 — 2/8	..	Nil
Do. 4 % Deb.	100	4	4	69 — 73	..	5 9 7
Do. 5 % Second Deb.	100	5	5	78 — 81	..	6 3 5
Electric Construction	2	Nil	Nil	3/8 — 1	..	Nil
Do. Pref.	2	7	7	1⅜ — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	10⅛ — 10⅜	..	6 10 3
Do. Deb.	100	5	5	102 —103⅛	..	4 16 7
General Electric, Pref.	10	5	5	8⅜ — 9⅛	..	5 8 1
Do. Deb.	100	4	4	88 — 93	..	4 6 0
Henley's, Ord.	5	15	15	12⅛ — 12⅞	..	5 16 6
Do. Pref.	5	4½	4½	4⅞ — 5⅛	..	4 7 10
Do. Deb.	100	4½	4½	106 —108	..	4 3 4
India-Rubber, G. & T.	10	10	10	15⅜ — 16⅛	..	6 1 3
Do. Pref.	10	5	5	10⅛ — 10⅜	..	4 13 0
Telegraph Construction	12	17½	20	36½ — 38½	..	6 5 0
Do. Deb.	100	4	4	100 —102	..	3 18 5
Willans & Robinson	1	Nil	Nil	1/8 — 3/8	..	Nil
Do. Pref.	5	3	Nil	1/4 — 1	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3 1

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 3 per cent., March 9th, 1911.

NOTES ON ELECTRIC STREET LIGHTING.

By L. CROUCH.

(*Concluded from page* 979.)

Areas Lighted by Various Lamps and per Candle-Power.—The area over which a given lamp, as suspended in street lighting, will effect not less than a stated minimum illumination is generally circular in form. In ordinary streets a large portion of this circular area falls beyond the building line on either side, and of the illuminating possibilities of the rays within the segments so cut off by house walls, &c., only a very small percentage is reflected. The remainder is a dead loss so far as concerns the street illumination.* Thus the area of street surface which a given lamp (with a uniform horizontal polar C.P. curve) will effectively illuminate, depends on the width of the street. A lamp centrally hung in a wide street may be able to light its full circular area as above, whereas with the same lamp hung at the side of a narrow street, use could only be made of a relatively small part of this area (see cases A and B, fig 6). The following information is therefore only of restricted value.

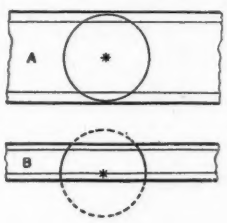


FIG. 6.

Using any source of light similar to arc lamps (as regards polar distribution) the requisite allowance of mean lower hemispherical C.P. may be determined on the basis of :—

For fair illumination, 0·044 C.P./ft.² = 0·518 hef./metre².
" good " 0·078 " = 0·917 "
" brilliant " 0·167 " = 1·97 "
(1 C.P./ft.² = 10·78 C.P./m.² = 11·77 hef./m.²)

The exact area which a lamp effectively illuminates depends on the height at which the lamp is suspended, but since (*a*) the height of suspension varies between fairly narrow limits for each type of lamp (say 25-35 ft. for arcs, and 10-20 ft. for incandescent filament lamps), and (*b*) the opposing factors $\left(\sin \alpha \text{ and } \frac{1}{h^2}\right)$ tend to keep the illumination constant as the lamp rises—therefore the factor "candle-power per sq. ft." has some significance apart from the height of suspension.

A 10-amp. arc suspended at 20 ft. will brilliantly illuminate a circle of 50 ft. radius or poorly light one of 100 ft. radius; a 16-C.P. filament lamp hung 7 ft. above the street level very well illuminates a circle of 8 ft. radius (see also Table X).

TABLE X.—Areas Lighted.

Lamp.	C.P.	Ht. of suspension. Ft.	Area lighted. Sq. ft.	Rad. of equiv. circle. Ft.	C.P. per sq. ft.	Illumination.
Filament	16	7	200	8	0·080	Good
Arc ...	800	20	15,500-22,650	70-85	·052-·035	Fair
Arc ...	1,000	20	7,850	50	0·128	Brilliant
Arc ...	1,000	20	31,400	100	0·032	Poor

Power Consumption per Sq. Ft. per Candle-Foot.—On this point it is even more difficult to generalise than in the preceding section, hence the subjoined data (all by Bloch, 1909) are presented without further comment. These figures are useful indications of the *order* of the probable consumption in various cases, and may be taken as the average of many actual installations. Beyond acting as a check or "control" on any proposed scheme, the information is of limited utility.

Power Consumption in Street Lighting—Bloch.—

	Watts/sq. ft./candle-ft.
Carbon-filament lamps	0·9—1·3
Nernst and tantalum lamps	0·4—0·65
Metallic-filament lamps	0·28—0·45
D.C. arcs, pure carbons (open)	0·17—0·28
" flame	0·055—0·13
	Cubic ft./hr./ft.²/candle-ft.
Incandescent gas (vertical)	0·016—0·024
Ditto high pressure ...	0·012—0·024
Incandescent gas (inverted)	0·010—0·018
In certain Berlin streets :—	Per sq. ft. per candle-ft.
"Alba" flame arcs	0·0655 watt.
Inverted H.P. gas mantles	0·0077 c.-ft.

A useful factor in this connection is—

Consumption per sq. ft. per candle-ft. = 1·093 × consumption per sq. metre per lux ;

or, inversely—

Consumption per sq. metre per lux = 0·915 × consumption per sq. ft. per candle-ft.

Use of Globes and Lanterns, and Effect of Same.—Globes are necessary with arc lamps, partly to screen the arc from wind, rain, &c., but mainly to prevent damage by falling particles of hot carbon, and to *diffuse* the initial *high intensity* and *local nature* of the luminous source (see Table IV). Opal globes will always be necessary with arc lamps if only on this account, while, from the purely illuminating standpoint, no inclined-carbon arc lamp should now be considered complete without a dioptric inner globe. The absorption of the globe leads to a certain decrease in efficiency of the lamp as a whole ; thus, according to Görges, the efficiency of large Beck arc lamps of from 6,000 to 14,000 M.S.C.P., with and without globes, is :—

D.C. no globe 0·188 watt/M.S. hefner, with globe 0·303 w./M.S. hef.
A.C. " 0·409 " " " 0·658 "

thus the power consumption per mean spherical hefner may rise by about 60 per cent. on fitting the globe.

Edgcumbe and Morris respectively quote the following data :—

TABLE XI.—Globe Absorption.

Type of globe.	Edgcumbe % absorption.	Morris and Farrow.	
		% absorption.	Size of globe.
Clear glass	5—15	14½—15	13 in.
Rippled glass	20—25	...	...
Ground glass	30—40	...	...
Heavy ground	40—50	...	...
Slightly opalescent ...	...	15—24	11 in.
Heavily " ...	50—60	...	...
Small opal	...	17—18	8 in.
Large opal	...	27—32	16 in.
Holophane	20—30	...	...

It should be noted that large globes absorb a greater percentage of incident light than do smaller ones of similar construction ; the choice of a suitable globe diameter therefore becomes a matter of some importance. Kennard* proposes a convenient formula for the determination of the diameter of arc lamp globes. Thus :—

$$D = 0{\cdot}565\sqrt{\frac{\text{C.P.} \times K}{\rho}}, \qquad \ldots \quad (2)$$

where D = globe diameter in mm, or inches according as C.P., K and ρ are used in the metric or English units, as follows :—

Metric.		*English.*
Mean spherical bougie C.P.	C.P.	Mean spherical English C.P.
Intrinsic brightness of globe in bougie per mm.²	ρ	Intrinsic brightness of globe in C.P. per sq. inch.
See Table XII.	K	See Table XII.

The required brightness ρ of the globe varies from 0·0016 bougie per mm.² (0·94 C.P. per in.²) downwards ; a value of 0·0004 bougie/mm.² (0·24 C.P. per in.²) is a reasonable figure for arc globes.

The values to be substituted for the constant K are as follows :—

* Before the Illuminating Engineering Society of America there was described by Sharp (May, 1910) an ingenious reflector to be applied to metallic-filament lamps or small arc lamps with a view to saving this cross-street light.

* *La Lumière Electrique*, Vol. 9, p. 68.

TABLE XII.—CONSTANT K (FORMULA (2)).

Type of globe.	K.	Type of globe.	K.
Clear glass	0·90	Ground glass ...	0·70
Holophane glass ...	0·85	Opalescent glass ...	0·65
Clouded glass... ...	0·80	Heavy opal glass ...	0·50

Incandescent filament lamps, whether of the carbon, Nernst, or metallic types, are generally used without prismatic or opal globes. Some form of clear "lantern" or globe is, however, usual, as a protection to the bulbs against dirt, wind, rain, snow, ice and mechanical damage. The life of non-enclosed lamps is generally considerably shorter than that of bulbs used inside a ventilated "lantern." Thus the average life of tungsten lamps in street service has been found to rise from 1,700—1,800 hours when run in the open to 2,400—2,500 hours when protected by a lantern. Of late it has become commoner practice to run incandescent lamps without enclosure of any kind; it is yet rather early fully to judge the merits and likely developments of this system. An *air-tight enclosure* is, however, very detrimental to the life of filament lamps, probably owing to the higher running temperature, the enclosed air within the lantern reducing the cooling facilities. By providing several ventilation holes in the lantern panes or globe, this trouble is entirely overcome.

Arc Lamps versus Metallic-Filament Lamps.—To consider fully the conditions under which arc lamps can advantageously be replaced by metallic-filament lamps, and the arguments for and against such replacement, would require more space than is here available. The problem is mainly a financial one, and various papers thereon have lately appeared in the technical Press. The efficiency of arcs of less than 600-700 C.P. is very poor; the prime cost of the lamps is relatively high, and their upkeep charges are heavy. Where choice is possible, no smaller lamps than 1,000-C.P. units should be installed; these, if of the open D.C. type, require 40-45 volts each, so that, for efficiency, four or five should be run in series on 200-250-volt supplies. This at once shows that arc lighting is economically confined to instances in which considerable lengths of street have to be fairly highly illuminated. Without going further into details, the statement that illuminating schemes requiring units of 600 C.P. or less are better served by metallic-filament than by arc lamps may be supported by the following excerpts :—

1. "For candle-powers up to and including 500-600 C.P., groups of tungsten lamps are cheaper and better than open type arcs (giving 500—600 C.P. at 10° below horizontal)."—Harrison.

2. "The running costs of small arc lamps total 35—46 per cent. higher than for tungsten lamps."—Tests by Monasch, Bloch and Hoppe.

3. Metallic-filament lamps can successfully compete with small arcs (magnetite or ordinary).—P. D. Wagoner, tests and figures.

And *by makers of both types of lamp.*

4. Metallic-filament lamps compare favourably, in first and running costs, with enclosed arcs and burn in any position.—Maker A.

5. Have recently carried out many schemes in which tungsten replace arc lamps.—Maker B.

6. Metallic-filament clusters compare favourably with our five-ampere arcs; the cost of operation is much reduced; the expense of carbons and trimming is eliminated.—Maker C.

Similar opinions could be quoted indefinitely; the small arc lamp is rapidly becoming obsolete on the triple ground of its low electrical efficiency, high attendance costs and high initial cost.

An interesting, self-explanatory analysis of the present use of various types of electric lamps in street lighting in the United Kingdom is presented in Table XIII.

Poles and Fittings.—This heading again requires a separate thesis for its adequate treatment, and the present notes thereon must be very superficial. Considering briefly the types of poles and fittings employed in steet lighting and the relative costs and advantages of various types, the following results are reached. Arc lamp supports may be of the bracket type secured to the side walls or houses, or to the standards of trolley tramway systems where such are available; or the independent side or centre pole may be used. In either of the latter cases the lamp may be hung from the end of a projecting bracket on the pole or from the extremity of a downward bending "swan-neck" finial or, again, it may be hung, like the "bob" of a plumb line, in a loop formed at the head of the pole.* The main point to be observed is to secure minimum obstruction of light by the supporting pillar or arm. From this point of view the best arrangement is the overhanging bracket from the end of which an inclined-carbon lamp with dioptric globe is freely suspended. Cheapness of pole can now be combined with artistic merit. Posts from 15 to 20 ft. high average £10 apiece if fairly plain, up to £15 or £20 if highly ornamented: plain poles suitable for small arcs can be obtained from £5 upwards. For very tall poles a steel lattice construction is cheaper, lighter and stronger than cast poles. For heights of 30 ft. and over, lattice poles cost about 10s. per ft.

TABLE XIII.—SHOWING APPROXIMATE PRESENT USE OF VARIOUS LAMPS IN STREET LIGHTING IN THE UNITED KINGDOM.

Incandescent lamps.		Arcs.	
Carbon.		*Enclosed.*	
16 C.P. and under ...	3,000	5—7 amp.	1,000
25—50 C.P., inclusive	1,700	Miscellaneous ...	2,400
Miscellaneous ...	3,600	*Open.*	
Nernst.		5—7 amp.	720
½ amp.	980	7—10 amp.	6,400
1 amp.	150	12—15 amp.	1,150
Miscellaneous ...	570	Miscellaneous ...	3,400
Metallic.		*Flame.*	
16 C.P.	1,300	8—10 amp.	1,500
25—50 C.P., inclusive	10,900	Miscellaneous ...	2,200
100 C.P.	2,500		
200—1,000 C.P. ...	400	Mixed arcs	8,500
Miscellaneous ...	37,000		
Carbon and metallic mixed	12,900		

Both arc lamps and incandescent lamps are occasionally provided with arch supports spanning the whole street and secured to the house walls. Such a method ensures freedom from obstruction to traffic or light by the supports, and is capable of very artistic treatment. It is, however, costly, and the massive iron work required by a self-supporting arch is frequently ludicrously disproportionate to the lamp whose support is its primary object. Incandescent-filament lamps frequently employ previously existing gas standards and lanterns, even the gas barrel up the standard being sometimes used to carry the cables: where gas is being replaced by metallic-filament lamps, the old fittings can usually be employed with a very small added expenditure. Should new posts be necessary these will cost £2 to £3 each. The holders and suitable reflectors for units or groups of filament lamps are provided by many electrical firms in all possible forms. Some idea of the cost of the fittings (excluding posts) has been given in Table I.

Annual Costs of Various Systems of Street Lighting.—In this, the concluding, section of this article, some attempt is made to set forth the relative importance of the various items which go to make up the total annual cost of any street lighting equipment. This being done, the usual contract prices for energy supply to and upkeep of various types of electric street lamps are stated and analysed.

The headings under which the annual cost of any lighting system may be considered are :—

Capital charges—say 5 per cent. interest + 5 per cent. depreciation.
Energy charges—dependent on the cost per B.T.U.
Renewals—including carbons in arc lamps.
Attendance—cleaning, trimming and renewals.

* This type of pole was very successfully employed in the recent City of London street-lighting scheme. Its great disadvantage—impossibility of lowering arc lamps thus suspended—has been avoided by the addition of a pivoted U or "harp" frame. (See ELECTRICAL REVIEW, December 30th, 1910.)

The relative importance of these items varies mainly with the cost per B.T.U. and, of course, with the type of lamp. Fairly representative percentage values of these charges in various cases are as shown in Table XIV. The C.P. of units, the price of energy and the general scale of the equipment have a great influence on these results. The conditions assumed in preparing Table XIV are those on which the later analyses of costs are based.

TABLE XIV.—PERCENTAGE VALUE OF VARIOUS ANNUAL CHARGES.

Type of installation.	Percentage value of			
	Capital charges.	Energy.	Renewals.	Attendance.
Ordinary arcs	6·0	81·8	3·6	8·6
Flame „	10·8	50·6	23·2	15·4
Metallic filaments ...	7·1*	79·6*	11·7*	1·6
Carbon „ ...	9·7	82·3	5·7	2·3

* Now somewhat reduced (see Tables I and V).

The above table deals solely with the relative magnitude of the various charges for different lamps; the absolute costs per 1,000 C.P.-hours in the several cases depend on so many variables, would require so much space to be devoted to their estimation, and have been so fully treated elsewhere, as to exclude them from present treatment. The value of such general estimates is doubtful, for, owing to the great number of variables concerned, it becomes impracticable to allow for changes in all of them. However, readers who desire to study tables of this description may find very instructive examples of the same in "Electric Lighting" (Solomon, 1908), pages 271, 292, 294-5, and scattered through the technical Press for several years past.

Averages taken over a large number of actual contracts (between the two departments concerned,† of municipalities, or between private supply companies and municipalities) give the following mean charges per annum for energy supply and complete maintenance of the lamps stated :—

	Per annum.
16-C.P. carbon-filament lamps	£2 to £3
60-C.P. metallic ditto (one or more lamps)	£3 to £6
1,000-C.P. (average) arc lamps of various types	£12 (exceptional) to £25, say £16 average.

Analyses, showing the general manner in which these inclusive charges are made up, are subjoined; the assumptions made are clearly stated, and are as representative as possible. (The cost of running arc lamps has been considerably reduced since the present examples were chosen.)

For the filament lamps an energy cost of 3d. per B.T.U. is assumed throughout; this is fairly representative of small towns where such lamps are used for street lighting. To be economically permissible, arc lamps require a much cheaper energy supply, hence 1¾d. per unit has been assumed for these lamps; this rate can be bettered in many large towns.

(1) *16-C.P. Carbon-Filament Groups.*—Assume two lamps per post: cost of post, £3; lantern, &c., £1; lamps, 2s.; switch, 3s. 6d.; cable, 2s.; miscellaneous, 5s.; erection and connection, £1 (probably too heavy); total capital per pole, £5 12s. 6d.; hence 10 per cent. on half capital = 5s. 8d. per lamp per annum. Assume η 4 watts per C.P., a life of 900 hours, and 3,000 burning hours per annum (see figs. 1 and 2):

$$\text{Energy cost} = \frac{16 \times 4 \times 3{,}000}{1{,}000} \times 3\text{d.} = £2\ 8\text{s.}$$

Renewals = 3,000/900 × 1s. = 3s. 4d.

Attendance (say, 2 hours per lamp per year, at 8d. per hour) = 1s. 4d.

Total cost per lamp per annum = £2 18s. 4d. ... (3)

(2) *60-C.P. Metallic-Filament Groups.*—Assume two lamps per post: cost of lamps = 10s.; other capital expenses as in (1). ∴ Capital cost per lamp = £3 0s. 3d., and annual 10 per cent. thereon = 6s.

Assume η 1½ watts per C.P., life 1,500 hours, and 3,000 burning hours per annum: then—

$$\text{Energy cost} = \frac{60 \times 1{\cdot}5 \times 3{,}000}{1{,}000} \times 3\text{d.} = £3\ 7\text{s. } 6\text{d.}$$

Renewals = 3,000/1,500 × 5s. = 10s.

Attendance, as in (1) = 1s. 4d.

∴ Total cost per lamp per annum = £4 4s. 10d.... (4)

(3) *1,000-C.P. Arc Lamps.*—It is much more difficult to prepare general estimates for these lamps, since so much depends on the exact type of lamp, regulation, and carbons employed.

The cost of poles (one lamp per pole) will here be about £10; the necessary hoisting gear and other accessories, £2; the lamp itself, £4 10s.; erection, connection, switch and miscellaneous, £3 10s.; cable, 16s.; total capital cost per post, £20 16s. Annual capital charge per lamp = £2 2s.

Case (a)—Ordinary Open Arcs.—

Assume η = 1·3 watts per C.P.

$$\text{Energy cost} = \frac{1{,}000 \times 1{\cdot}3 \times 3{,}000}{1{,}000} \times 1{\cdot}75\text{d.} = £28\ 10\text{s.}$$

Carbons, say, £1 5s.

Attendance, say, £3 (= ¼ hour per lamp per day, at 8d. per hour).

Then—

Total cost per lamp per annum = £34 17s.* ... (5)

Case (b)—Flame Arcs.—

Assume η = 0·45 watt per C.P.

Energy cost = £28·45 × 0·45/1·3 = £9 16s.;

but the impregnated carbons will cost some £4 10s. per annum. The remaining items being as in case (*a*), it follows that the

Total cost per lamp per annum = £19 8s.* ... (6)

Which particular examples amply illustrate the manner in which the annual contract rates are determined, and confirm the average values of the same cited above.

GLOBES, SHADES AND REFLECTORS.

BY C. TOONE.

(*Continued from page* 981.)

GLOBES, SHADES OR REFLECTORS—WHICH?

Before commencing this discussion it is necessary to define precisely what is meant by each term in the present connection.

"*Globe*" is taken to mean a completely enclosing screen of more or less translucent material placed round the primary source of illumination.

"*Shade*" is taken to mean a portion of a "globe," *i.e.*, a more or less translucent material screening direct lighting from certain directions only. Otherwise, a "shade" may be regarded as a translucent "reflector."

"*Reflector*" is taken to mean an opaque screen or "shade" completely cutting off radiations from the primary source in certain directions, and, by reflecting these rays once, twice, or more, as may be necessary, concentrating the total luminous flux in a direction dependent upon the position of the source and the geometrical shape of the reflector surface.

It must be noted that these definitions are more or less arbitrary, and by no means absolute.

"Globes" are, in general, used for diffusing purposes and for reducing the apparent intrinsic brilliancy of the source—the surface of the globe being, in effect, the luminous source unless the primary source is clearly visible through the globe, in which case the value of the latter, as a "brightness" screen, rapidly decreases as the opacity of its material diminishes. Globes are generally employed when equal screening and equal diffusion are required in every direction. Clear globes should never be used, unless for enclosing arcs

† Electricity Supply Department and the Streets Management and Upkeep Department.

* Considerably lower values for (5) and (6) are now obtained but the object of these examples is to show *how* the various annual charges are built up. Individual cases vary so greatly that it is impracticable to take more than isolated specific examples.

or for other purposes where mechanical *enclosure* is the desired object; such globes, while absorbing 10 per cent. or more of the total light from the source, do nothing to diffuse the latter.

"Shades" are usually employed where as much unrestricted radiation is desired, as is consistent with immunity from directly incident light. The opacity of a shade should be no less than that of the globe which might replace it; clear, transparent or lightly "figured" shades are useless as such, and should only be employed for special decorative purposes, and with a full appreciation of their worthlessness as diffusing media. These remarks apply alike to the bracket—or pendant—lampshade, and to the glass or silk shade usual on table lamps.

"Reflectors" find their chief application in shop lighting, behind all "concealed" or "inverted" lamps, and in all cases where a concentrated light is required, any stray light being brought back as efficiently as possible. Reflectors may be of polished metal or silvered glass, in which case highly-efficient *direct* reflection will be obtained; cheap reflectors of this class are apt to give "streaky" illumination, but good direct reflectors are essential for searchlights, stage lighting, and, to a less extent, for concealed lighting, shop window lighting, and so on. For domestic work, inverted lighting and many miscellaneous applications, white enamelled metal reflectors are used, the diffuse reflection obtained being uniform and efficient. (Table IV.)

The elementary forms of lamp screen are combined more or less completely in practice; thus, "globes" are often partly of clear glass silvered on its outside surface, the portion so treated, acting as an efficient "reflector," and the concentrated illumination otherwise obtained being then diffused by the remaining or globe portion of the whole. Similarly, the clear "globe" of an electric filament lamp is often frosted to convert the treated portion into a "shade," while, in other instances, part of the clear globe is silvered to act as a "reflector" (*e.g.*, for shop lighting purposes).

Again, "globes" and "reflectors" have frequently to be used in conjunction, the most familiar instance of this being in street lighting; a more or less opalescent globe is then required to protect the eye from the intense directly incident rays while a reflector is necessary to correct the polar distribution of light towards that more conductive to uniform lighting over a long and comparatively narrow area. (For street lighting the uncorrected result of the use of an *opal* globe (more or less uniform distribution in every direction—see later sections) is *not* required; what is needed is maximum intensity in a direction some 10°—15° below horizontal. A recent form of reflector for street arcs is somewhat as

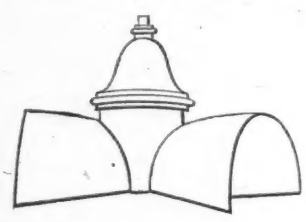


FIG. 1.

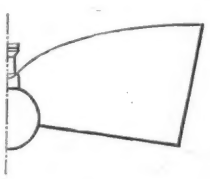


FIG. 1A.

sketched in fig. 1, its effect being to give a net distribution curve more of the type shown dotted in fig. 2 than the normal (full curve) form given by the arc alone. This reflector has been used in America—in conjunction with arcs enclosed in opal globes—with considerable success, a very uniform distribution of illumination resulting from its use.)

While it is thus impossible to sharply demarcate and isolate globes, shades and reflectors, it is clear that "globes" are generally required for softening and diffusing effects, while "reflectors" concentrate illumination—both as regards intensity and distribution. "Shades," while having their own special applications, are at present used somewhat too widely and (very frequently) in a wholly useless manner. Thus thistle shaped shades (fig. 3), used mouth downwards, are extremely common; they afford no protection in a downward direction, and, in fact, their whole effect, when used on wall-brackets, chandeliers, &c., is to cut off a large percentage of light which would otherwise travel directly to the walls and ceiling of the room, thence obtaining excellent diffusion. Such shades are often figured or clear stained, and in either case have a high absorption factor with practically no diffusive power. All screens or shades, other than properly diffusing globes or distributing

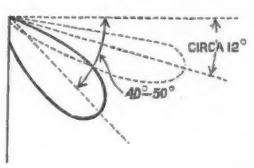


FIG. 2.

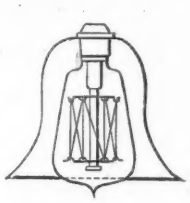


FIG. 3.

or concentrating reflectors, should permit of the walls and ceilings of the room being flooded with light, their own function, except in purely artistic schemes, being confined to screening the eye from directly received illumination of too high brilliancy.

An ideal shade should be opaque and have a good internal reflecting surface if it is to act as a "reflector-shade," or should have a sufficient (see above) and uniform opacity if it is to act as a "globe-shade." Its area and location should be such as to completely screen the eye from all excessively bright illumination, but, for the rest, it should permit a *maximum of direct illumination without* the intervention of glass, reflection, or any other source of inefficiency.

There is distinct advantage in using suitable shades or reflectors instead of frosted globes, in the case of incandescent-filament lamps, for the deterioration of the latter is appreciably hastened whether their own bulb be frosted or (to a less extent in this case) enclosed in a frosted outer globe; the effect is traceable in part to the burning-on of external dust (in the first case), and in part to the higher working temperature attained by the lamp.

Type of Screening Device for Various Services.—Some information on this heading has necessarily been included in the preceding section, but, in addition to the remarks there made, the following points may be noted.

In street-lighting, frosted or sand-blasted globes, though seldom employed, are preferable to opal globes, in that they give sufficient softening of intensity, while creating a minimum distortion of the natural distribution of the luminous source. In workshops of all descriptions clear globes should be banned, except for purposes of mere enclosure, absorption of ultra-violet rays, and so on, in which instances they must be supplemented by such additional screening as may be necessary to sufficiently protect the eye against intensity and contrast. Hygienically, inverted illumination is preferable to all other.

Shop window lighting generally requires uniform top lighting (by concealed lamps), and, in the main window space, lamps screened on their street side so as to throw their illumination wholly or mainly inwards. Churches and concert halls require uniform and unobtrusive lighting; well diffused top lighting is usually eminently suitable, and in churches in particular, great room for improvement still exists. For libraries, lamps slung about 2 ft. from the ceiling level, and enclosed in "prismatic" glass or globes of "crystal" glass roughed externally, give excellent general illumination, while, for local illumination, lamps screened by opaque reflectors are suitable for bookshelves and table reading lamps; wall bracket lamps should be surrounded by deep diffusing shades, or preferably enclosed in prismatic diffusing globes.

The conditions of domestic lighting vary too widely to permit of any approach to detailed treatment; the choice of the type of screen adopted is regulated mainly by æsthetic considerations, but, while paying great attention to artistic effects, the prime importance of physiological requirements must not be neglected. In other instances, *e.g.*, on staircases, lift landings, &c., ample lighting must be so distributed as (in the examples chosen), to show up clearly the steps, lift gate and so on; decorative results then assume secondary importance.

Globe Materials, Characteristics and Absorption Coefficients.—Diffusing globes may be of clear glass, etched or sand-blasted on their outer surface (in which case they are termed "frosted" globes) or they may be of a homogeneous glass in which the diffusing medium is uniformly disseminated through the material during manufacture, as a more or less opaque pigment; generally the latter is of milky white or cream colour, but straw-yellow or orange tints are used at times. According to the depths of the pigmenting in the latter class, various more or less arbitrary trade names (varying with locality and maker) are applied to the globes. In general, "opaline" means the flushed-milky, nearly clear globes used round carbon arcs for street lighting and similar purposes; "opal" refers to a denser white colouring of the globe; "opalescent" refers to a pearl—or straw-tinted opal, and is often of too highly absorbent a nature for general use; while "alabaster" globes are made of a fluorspar mixture and involve very high absorption losses.

"Holophane" globes are so called by the makers of a certain class of scientifically designed prismatic diffusing globes and reflectors. The glass itself is quite clear and, by carefully applying the principle of total prismatic reflection, very remarkable distributing or concentrating effects are obtained at will, and with a very low absorption loss. Such globes must be designed with a full recognition of the ends to be attained and "cut-glass" globes, manufactured haphazard without regard to the optical properties of the finished whole, give (except by chance) very unsatisfactory results and patchy illumination due to the same prismatic reflection which, properly applied, constitutes the merit of "Holophane" globes.

Frosted globes have a comparatively low absorption factor (see below), but, in addition, they have low diffusing value; thus a frosted globe enclosing a filament lamp appears, to an observer a short distance off, as a more or less intense spot of light in the centre of a much dimmer halo. Synonymous with this statement is the fact that a frosted globe does not greatly distort the original curve of luminous distribution of the source of light it encloses, and though this is an advantage in some applications (*e.g.*, in street lighting), it is, in other cases, a sufficient disadvantage to more than compensate for the low absorption of the material.

Opal globes, and their derivatives as above classified, give a much better diffusion of light (and a correspondingly greater absorption loss) if moderately dense and well made, but slightly opalescent globes and opal globes of inferior make give a "red-hot-hairpin" effect—*i.e.*, permit the filament of a contained glow-lamp to be seen as a clear red thread. Needless to say, this state of affairs is no less injurious than the bright "spot" effect of frosted globes, and to secure that neither defect be apparent in a completed installation, it is well to specify that the filament of the lighted lamp (or the crater of an arc) shall be invisible in every direction, and shall yield no undue "spot" effect when the lamp is enclosed in a globe of stated size and viewed from a distance varying from 6 in. to 2 ft., according to the use to which the globe is to be put. It is further necessary that this test should be performed with a lamp of the type and candle-power ultimately to be employed within the globe, for a globe which will satisfactorily screen a carbon-filament lamp may be quite inadequate for a metallic-filament lamp (see Table I).

A white, cream or straw-tinted opal globe, with its outer surface roughened by blasting or etching, gives a softness and richness of effect which it is difficult to rival by any other means, but the absorption loss is naturally high in such a case. A straw-tinted opal globe is often beneficial in softening and "warming" the intense white illumination of the carbon arc, but once again the improvement must be dearly bought by a sacrifice of efficiency. Diffusing illumination by translucent globes is a difficult and costly matter, both as regards the manufacture of a suitable material and the loss of light during working, while both difficulty and inefficiency are aggravated when it is considered desirable also to attempt colour correction by the globes.

Prismatic diffraction is undoubtedly the most generally satisfactory and economical means of diminishing the effective brilliancy of luminous sources, diffusing illumination and blurring shadows, but prismatic globes are themselves costly and heavy, and are, in many applications, considered æsthetically inferior to opal globes, which present a more unbroken and uniform luminous surface to the observer. In the manufacture of opal globes it is possible to control the local density (opacity) of the glass to a certain limited extent, so as to meet any broad requirements; thus certain street-lighting arc-lamp globes have a central belt of comparatively clear glass, while a denser lower zone reduces the intensity of illumination in the immediate vicinity of the lamp, and, in fact, corrects the luminous distribution curve, imperfectly but distinctly towards the ideal represented in fig. 2.

So far, it has been sufficient to speak of the absorption of various globes in a perfectly general manner, but now, before giving quantitative data on this point, we must define precisely what is meant by "10 per cent. absorption." It may first be stated that the absorption factor of a globe must always be determined by employing the lamp proper to the globe; thus, the absorption factor of an arc lamp globe, as determined by tests made with an incandescent filament lamp, is not, of necessity, at all related to the actual absorption exerted by the globe when used in conjunction with its own arc lamp: hence—though experimentally convenient and, at first sight, more accurate—such a method of testing is practically valueless.

Again, it is not sufficient to merely determine the ratio between the candle-power of the lamp in a certain direction with and without the globe: the mere act of enclosing an arc lamp will materially alter its own polar curve of distribution, while the secondary curve (*i.e.*, the distribution outside the globe) will, in any case, be very different to that of the naked lamp. The light emergent in a given direction from an enclosed lamp will be composed of a certain percentage of the light incident along that direction from the primary source itself, together with a considerable percentage of light reflected from other parts of the globe: the total emergent light may, therefore, equal or be greater than the light travelling in that direction from the unenclosed lamp. In such a case the absorption coefficient, on the above, single direction basis, will be *nil* or even negative.

As it is by the M.H.-S.C.P. or M.S.C.P. of a lamp, that its suitability for a given service is largely determined, so it must be by the reduction of this quantity that the absorbing effect of its globe is estimated. Assuming, therefore, that the absorption loss due to an enclosing globe is defined as

$$\left(1 - \frac{\text{M.S.C.P. or M.H.-S.C.P. } \textit{with} \text{ globe}}{\text{M.S.C.P. or M.H.-S.C.P. } \textit{without} \text{ globe}}\right) \times 100\ \%,$$

this factor has the mean values given in Table V for various materials. Preferably the absorption should be estimated by the loss in M.S.C.P. but, as will be readily appreciated, the difference between the value so obtained and that based on the reduction in M.H.-S.C.P.* will not be sufficiently great (in uniform globes) to enable discrimination between the two cases in a mass of general data such as that collected in Table V.

The serious losses occasioned by even a moderate coloration of the globe may be again commented upon. Opalescent globes exhibit selective absorption, particularly after a long ageing in service; in general, yellow light suffers somewhat heavier absorption than blue light, but in other instances, and particularly in old, ill-tended globes, blue light suffers the heavier absorption. In the case of tinted globes, the absorption is of course least for light of the same colour as the tinting pigment.

(*To be concluded.*)

Hotel Installation.—The Highland Railway Hotel at Strathpeffer opened last week has many up-to-date features. MESSRS. OSBORNE & HUNTER have put in the plant, wiring and other electrical work, while an efficient system of ventilation has been installed, including electrically-driven blowers and fans. The whole electrical installation was carried out to the designs and specifications of Mr. W. Arthur Ker, consulting engineer, of Glasgow.

* The absorption coefficient, as determined by loss in M.H.-S.C.P., will clearly depend considerably upon the polar curve of C.P. of the lamp employed within the globe.

REVIEWS.

The Rubber Country of the Amazon. By Henry G. Pearson. New York: The *India-Rubber World* Publishing Co.

The present volume is a welcome addition to rubber literature. While much has been written concerning the Eastern and other plantations and plantation rubber, the Amazon watershed, which still produces at least one-half of the world's supply of the raw material, has hitherto received scant attention at the hands of the modern book maker. The reason is not far to seek, and it is that the difficulties and not inconsiderable dangers attendant on travel in the South American rubber districts have not made it alluring except to the scientific enthusiast or the incurable wanderer. Those who were familiar with Mr. Pearson's earlier books naturally looked forward to the present volume with something more than ordinary interest, for Mr. Pearson is not only a traveller, but combines the qualities of the practical rubber man with those of the first-class technical journalist. He has, in addition, more than a fair share of his countrymen's sense of humour, and possesses the very rare quality of imparting serious information in a manner at once amusing and interesting. We will leave it to the reader to find out how Mr. Pearson got from Brooklyn ("a well-known suburb of New York") to Para; having arrived at Para, the author "gets down to business," and explains lucidly, but briefly, the organisation of the Brazilian industry, the methods of collecting and curing Amazon rubber, and the general economic conditions of the region. He is of opinion that, given labour and proper exploitation, four times as much rubber could come out of the Amazon as is obtained at present. The rubber camps are all located along the waterways, the territory rarely being worked for more than a mile inland. The rest of the forest—many thousands of square miles—is quite untouched. Not daunted by the accounts of fever and other evils to be encountered "up-river," Mr. Pearson travelled to Manaos, and an exceptionally interesting account of this thousand-mile trip on the Amazon is the result. Of the future of Manaos, the author has a high opinion. His general remarks concerning the city are well worth quoting, for they appear to us to contain the key to the Amazon problem. He says:—"When one considers that this city is a thousand miles from the seacoast, in the heart of a vast tropical jungle, with wild Indians within a hundred miles of it, its presence seems incredible. In a way it is as modern as New York or Chicago. The latest Parisian fashions are there, and almost anything that civilised man desires is obtainable. Prices are high, to be sure, because both luxuries and necessities are imported and subject to a duty of 100 per cent. But when something besides rubber is produced by the magnificently fertile lands that surround it, Manaos will be one of the great and beautiful cities of the world, and living as reasonable as anywhere. . . ." Given cheap food stuffs and other necessaries of life on the Upper Amazon and its tributaries, the main difficulty in connection with the labour problem will be solved. By means of a series of excellent maps and lucid descriptive matter, Mr. Pearson brings vividly before the reader the vast extent of the Amazon rubber districts in Brazil, Peru and Bolivia, the nature of the transportation difficulties, and the steps that are being taken—as an instance, we may refer to the Madeira-Mamoré Railway—to overcome them. Truly it is a wonderful country from Para in the east right away to the "Acre," Mollendo and Iquitos on the west, and Mr. Pearson deserves the thanks of all those interested in rubber for bringing it so clearly before them. "The Rubber Country of the Amazon" should find an abiding niche in the rubber library.

Electric Crane Construction. By Claude W. Hill. London: Chas. Griffin. Price 25s. net.

This book represents an enormous amount of industry on the part of the author. It also shows that he has something more than a superficial knowledge of electric cranes. We remember an excellent paper on the subject before the Institution of Civil Engineers by the writer of this work, so that he is not altogether a stranger to those who know the literature of the subject. This is the sort of work to which the man who wants to write a chapter about electric cranes in a text-book on the applications of electricity, or some similar and quite general subject, will go. It will also prove a mine of information to the practical man who wishes to design the equipment and lay-out of factories, &c.

The first seven chapters deal with the principal types of crane. The scheme of each chapter is very much the same. There is first a description of the construction and duty of each of the types mentioned. The stresses and other points peculiar to the type of crane, are then considered. The drawings and descriptions are good, and in many cases there are records of tests. These different types of cranes are (1) overhead cranes; (2) locomotive and portable jib cranes; (3) derrick cranes; (4) transporters; (5) sheer legs; (6) revolving cantilever cranes; (6) cableways. A 30-ton electric overhead crane is described in detail. It was constructed by the Cleveland Bridge Co. to the author's designs. Locomotive and portable jib cranes are dealt with in the second chapter. The method of working out the stresses (tension and compression) is shown clearly. Then follow descriptions of cranes built by various firms, and so on with the first seven chapters—it is all good matter and well put together. In Chapter VIII we have calculations and data on the power required for crane driving. Since it is usual to specify the time which the different motions of the crane shall take to move the load through definite distances, the question of starting torque and acceleration is fully discussed. In the chapter on design of crane structures, we have a somewhat lengthy discourse on columns, parts of which might, we think, have been with advantage abbreviated. The important work of Prof. Lilley, of Dublin, is included in the discussion, and we read that "the author prefers, therefore, to rely on Prof. Lilley's experiments, as, although made on comparatively small specimens, they were made on the material, mild steel, with which crane makers have to deal." There are many extremely useful and interesting stress diagrams in this chapter, as well as some beautifully clear working drawings of actual structures built in connection with cranes. Tables of the breaking loads of the British standard steel sections (where used for struts) are included.

The design of machinery has a chapter allocated to it. The subject is considered in very great detail. The author favours the use of ball-bearings for light work. It is also of interest to notice that gantry wheels of very hard steel are being introduced in order to lessen the wear—or in order to admit of higher working pressures.

Brakes are important, and there are many useful notes on the matter. The regenerative system of electrically controlling the speed of lowering is praised.

Fifty pages are devoted to the subject of toothed gearing. It is not an easy matter to explain, but the chapter is well written. Hooks, lifting magnets, ropes and chains have a chapter devoted to them. We are glad to notice a reference to the excellent paper by Mr. R. W. Chapman on the stresses in wire ropes. We might have had a little more about chains; some experiments in America on the subject have been published during the past two or three years.

The design of magnets is a short, but very thorough chapter. The author still recommends the formulæ published by him in an article in the Electrical Review in August, 1895. Motors, controllers and collectors are considered, and then we have the final chapter on crane installation; this is limited to dealing with the question of the types of crane, employment of accumulators on crane circuits, and so on. Before proceeding to design an installation, it is necessary to make a careful study of the duty which the installation, as a whole, is to perform.

It is clearly not possible to design any installations as standard. All will vary, although the fundamental principles of any installation will be learnt from a study of this book. If it were possible simply to repeat standard designs, there would be no need for consulting engineers and designers.

Enough has been said to show that the book is good—distinctly good—and deserves every praise. The numerous illustrations seem to have been reproduced regardless of trouble and expense. Possibly some of the photographs are somewhat superfluous, but he would be a carping critic who

would not willingly put up with these trivial blemishes to a really ably-written, well-arranged, and remarkably clear treatise.

La Technique de la houille blanche et des transports d'énergie électrique. By E. PACORET. Paris: Dunod et Pinat. Price 55 fr.

These portly tomes represent the second edition of the original work, reviewed in our columns some years ago, with considerable alterations and extensions, and a preface by Prof. Blondel. It now comprises, in two volumes, a total of 2,352 pages and 1,336 figures, besides 19 plates.

Taking "white coal" as the text—a term which a writer in the *World's Work* recently ascribed to Canadian literature, but which has been in use in Europe for a generation—the author treats of the whole realm of hydro-electric power, from the hydraulic works and machinery, in theory and practice, including the hydrology of mountainous regions, dams, conduits, turbines, &c., with examples from both hemispheres, to the theory and construction of electrical generating and transforming machinery, switchgear, transmission lines, &c., and the most important applications of electrical energy in connection with the continuous supply available for water-power. In a chapter on the world's water powers, the author states that France possesses an available power of 4½ million H.P. at the minimum flow, or 9 to 10 millions at the average flow. The world already utilises 6 million H.P. out of an estimated total of 65 millions; the United States lead the way with two millions developed, then comes France with 1½, Italy with ½, and Switzerland with ⅔ million. But Scandinavia appears likely to excel all other European countries in this respect, when the great undertakings now in progress are completed.

We cannot but admire the immense industry of the author, by means of which he has compiled this extraordinary treatise, dealing exhaustively with a subject of vast scope and complexity. Those who are interested in the development of large water powers will find here a wealth of information on every phase of the question. Our only complaint is against the binding, which is utterly unworthy of the work; the parts are held together by *but a single thread*, zigzagged through the folds, and it would be impossible to read through the volume without breaking its back.

Electric Motors: Their Action, Control and Application. By F. B. CROCKER and M. ARENDT. London: Crosby Lockwood. Price 10s. 6d. net.

This book deals with the subject of electric motors in quite a different manner from practically all existing books written in English. There are, of course, quite a number of books on electric motors dealing with the theory, design and construction of such motors, but the volume under consideration does not profess to treat either of the principles and constants of design or of practical constructive details.

The book contains the substance of a series of lectures on the subject at the Columbia University, and deals with the operation and method of working of electric motors. This section of electrical engineering has been either entirely neglected or treated in a very brief and somewhat scrappy manner in the ordinary books, and it has been necessary, up to now, for one to wade through the voluminous proceedings of the Institution of Electrical Engineers for much of the information contained in this book. Hence the book appears to fill a distinct want, inasmuch as there are large numbers of engineers who are concerned with the installing and running of electric motors driving machines, in addition to managers of manufacturing concerns, who are not interested in either the design or construction of motors, but to whom concise and accurate knowledge of economically applying and running electric motors is a vital necessity.

In connection with synchronous motors, copper damping grids are recommended as a cure for "hunting," but the interesting fact that it is possible to use too much copper in the construction of these grids is not pointed out. The whole subject of "hunting," it is worth noting, was treated of very thoroughly by Prof. B. Hopkinson in a paper read before the Royal Society several years ago.

There is a brief account of alternating-current commutator motors, both of the compensated series type as used by the Midland Railway Co., at Heysham, and of the compensated repulsion type adopted by the London, Brighton and South Coast Co. on their South London elevated line. On account of its relatively low efficiency, this type of motor is not likely to be much used, an important exception being, of course, railway traction.

Chapter XIX deals with the service conditions and applications of electric motors, and while very short, is one of the best in the book; it is pointed out that a radial drilling machine costs less and is more convenient with a 3 : 1 adjustable speed motor than with change-gear box and constant-speed motor.

The standardisation rules of the American Institute of Electrical Engineers are added as an appendix to the book.

The work would have been improved had a chapter been added giving the methods of ascertaining the power required to drive a few typical machines, together with some data actually obtained from cases where installation or conversion had been carried out.

At the end of each chapter a useful bibliography—both English and American, with a few Continental references—has been added. While American standards and machines are the principal ones chosen for description, these are sufficiently general to be of use in this country.

The subject is necessarily technical, and while a small knowledge of algebra and graphs is necessary to read the book, each case is illustrated as far as possible by a specific numerical example based upon current practice.

In conclusion, the book is well got-up, the print and diagrams being particularly clear, and a credit to both printer and publisher. It can be thoroughly recommended to anyone requiring an up-to-date and accurate treatise on the application of electric motors.—H. G. S.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

DENMARK.—The Danish Customs authorities have issued the following decisions as to the duties to be levied on electrical and similar goods imported:—

Accumulator boxes, consisting of india-rubber (ebonite or similar material) with lead inlaid ...	70 öre per kg.
Solutions of asphalt in light oils, imported under various designations, and used for painting metal as a protection against damp	20 "

N.B.—Otherwise these are dutiable as oils.

100 öre = 1 krone = 1s. 1½d. Kg. = 2·204 lb.

PORTUGAL.—The Portuguese Customs authorities have come to an arrangement with the French Government to the effect that the heading in the Portuguese tariff for instruments, implements and tools not specially mentioned in the tariff for arts and trades, agriculture and gardening, for which the rate of duty is 20 reis per kg., shall include all implements and apparatus by which manual labour is carried out or assisted. British goods do not as yet receive most-favoured-nation treatment in Portugal, consequently this concession does not at present apply to imports from the United Kingdom.

1,000 reis = 4s. 6d. Kg. = 2·204 lb.

JAPAN.—The Japanese Customs authorities have issued the following decisions with reference to the duties to be levied on certain goods under the new tariff which is to come into force on July 17th next:

Tension fuses, quantity fuses, &c., which are termed electric detonator fuses and have an explosive, for causing a detonation, attached to one end of the fuse, are to be classified as fuses under Tariff No. 231 (4) at the rate of 37·40 yen per 100 kin.

Duties on machinery are to be calculated on the net weight of the goods.

The duties levied on parts of machinery will be applicable only to parts imported separately. Complete machines imported in separate parts for convenience of shipment (whether or not shipped on one and the same vessel) will not be dutiable as parts of machinery.

Yen = 2s 0¼d. Kin = 1⅓ lb.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

13,430. "Wind power electric storage installations or apparatus." W. P. Perry. June 6th.

13,450. "Apparatus for regulating the voltage of electric generators." C. Turnbull, jun., and J. H. Holmes. June 6th.

13,469. "Controlling apparatus for electric motors, chiefly as used with electric lifts." A. Turner and R. H. Wilkinson. June 6th. (Complete.)

13,470. "Electrical weapon for use in offence and defence by policemen or others." W. F. Brownlee. June 6th.

13,483. "Magneto compound." J. Vigneault and J. A. H. Hebert. June 6th. (Complete.)

13,490. "Magneto electric lamp apparatus for vehicles." G. Luy. June 6th. (Complete.)

13,492. "Transmission of electric power." T. T. Kryshtofovich. June 6th. Complete.)

13,509. "Holders for shades or globes of electric and other lamps." G. T. Twigger. June 6th.

13,515 "Manufacture of electrotype plates." W. F. Lake. (C. B. Cottrell and Sons Co., United States.) June 6th. (Complete.)

13,525. "Manufacture of filaments for electric incandescent lamps." L. F. Richardson. June 6th.

13,542. "Manufacture of electrotype plates." W. F. Lake. (C. B. Cottrell and Sons Co., United States.) June 6th. (Complete.)

13,561. "Arc lamps." G. E. Tate and F. O. Monkhouse. June 6th.

13,570. "Regulators for dynamo-electric machines." British Thomson-Houston Co., Ltd., and A. A. Pollock. June 6th.

13,571. "Electromagnets." British Thomson-Houston Co., Ltd., and F. B. Wedmore. June 6th.

13,573. "Remote-controlling means for electric trolleys." M. Bleichert and M. P. Bleichert. June 6th. (Complete.)

13,574. "Remote-controlling apparatus for electrically-actuated travelling winches and the like." M. A. Bleichert and M. P. Bleichert. June 6th. (Complete.)

13,601. "Intercommunication telephone systems with secrecy." H. E. R. Roose and W. T. Finlay. June 7th.

13,604. "Thermo-electric generators." P. Ferra. June 7th.

13,605. "Generation of electric current." P. Ferra. June 7th.

13,615. "Manufacture of filaments for electric incandescent lamps." L. F. Richardson. June 7th. (Complete.)

13,623. "Air propeller driven by electric motor." A. Schaffer. (Convention date July 2nd, 1910, Germany.) June 7th. (Complete.)

13,641. "Telephone mouth-pieces." L. Steinberger. (Convention date, June 13th, 1910, United States.) June 7th. (Complete.)

13,648. "Electrical switch or operating devices." C. Stille. (Convention date, July 20th, 1910, Germany.) June 7th. (Complete.)

13,650. "Regulation of electric generators driven at varying speeds." British Thomson-Houston Co., Ltd., and A. P. Young. June 7th.

13,662. "Timing apparatus for magneto-electric ignition." R. F. Hall. June 8th.

13,676. "Insulators for high-tension electricity conductors." F. Clouth. (Rheinische Gummiwarenfabrik m.b.H.) (Addition to No. 1,009, 1910). June 8th.

13,685. "Electro-mechanical cut-outs." M. A. Codd. June 8th.

13,707. "Electrical measuring instruments of the dynamometer type." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) June 8th. (Complete.)

13,715. "Thermo-electric batteries." Dr. P. H. Suchting and F. Oloff. June 8th. (Complete.)

13,731. "Method of supplying electric furnaces with triphase currents." Societe Anonyme Electrometallurgique. (Procedes Paul Girod.) Convention date, June 9th, 1910, France.) June 8th. (Complete.)

13,750. "Metallic armouring for insulated electric cables." A. H. Howard. June 9th.

13,758. "Portable electric battery lamps." K. R. Smith. June 9th.

13,782. "Manufacture of electric accumulator electrodes and means for use therein." R. Pape. June 9th.

13,801. "Ammeters of the dynamometer type." Siemens Bros. & Co., Ltd. (Siemens & Halske Akt Ges., Germany.) June 9th. (Complete.)

13,808. "Electro-deposition of metals." A. Rodeck. (Convention date, June 10th, 1910, Austria.) June 9th. (Complete.)

13,817. "Electric arc lamp electrodes." Gebruder Siemens & Co. (Convention date, June 29th, 1910, Germany.) June 9th. (Complete.)

13,830. "Electric circuit controlling devices." P. Dunning. (Convention date, June 10th, 1910. United States.) June 9th. (Complete.)

13,877. "Speed regulation of polyphase-series motors." Siemens Schuckertwerke Ges. (Convention date, June 10th, 1910, Germany.) June 10th. (Complete)

13,884. "Microphones." A. Rosenberg. June 10th.

13,886. "Detachable coupling for electrical connections." H. D. Thomas. June 10th.

13,887. "Telephone exchange switchboards and arrangements." E. A. Graham. June 10th. (Complete.)

13,888. "Electric lighting of motor road vehicles and the like." W. F. Grafton. June 10th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

Electrolytic Production of Antimony. W. Ruthenburg. 19,772. August 24th.

Electric Furnaces. M. Reid. 19,804. August 24th.

Permanent Magnets. G. Hookham. 20,374. September 1st.

Rotary Absorption Dynamo Meters. R. N. Ehrhart. 22,285. September 26th. (October 27th, 1909.)

Telephone Receivers. C. Baehr. 23,748. October 13th.

Sparking Plugs for Internal-Combustion Engines. A. Ginestes. 27,991. December 1st.

Controlling of Aerial Vessels by Wave-Transmitted Electricity. T. E. R. Phillips. 6,316. March 14th.

Mode of Controlling Electric Lights and Apparatus therefor. R. J. Aiken. 11,854. May 18th.

Method of and Means for Varying the Voltage in Alternating Electric Current Circuits. H. J. Herberts. 11,951. May 13th.

Control of Electric Motors. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 12,026. May 14th.

Electrical Heating Appliances. L. Newitt and F. P. Fletcher. 12,322. May 19th.

Switch Apparatus suitable for use in Electrical Distribution Systems. F. E. Berry. 12,427. May 21st.

Entrance Devices for Tramway Vehicles and the like. W. D. Jones. 12,521. May 23rd. (May 24th, 1909. Addition to No. 3,717 of 1910.)

Negative Plates for Storage Batteries and Processes for the Manufacture thereof. P. G. Salom. 12,625. May 24th.

Alloys useful as Electric-Resistance Conductors. British Thomson-Houston Co. (General Electric Co.) 12,757. May 25th.

Means for use in Controlling Induction Motors. Electric Construction Co. and N. Pensabene. 13,962. June 9th.

Alternating Current Dynamo-Electric Machines. Allgemeine Electricitäts Ges. 14,024. June 9th. (June 19th, 1909.) Patent of Addition not granted.

Process for Providing Electric Conductors with an Identifying Covering. J. Bowyer and Anchor Cable Co. 15,792. July 1st.

Apparatus for Operating Railway Switch Points. E. C. Irving. 16,157. July 6th.

Electrically-Operated Playing Apparatus for Musical Instruments and Music Sheets therefor. D'Arcy M. Clark. (Telelectric Co.) 16,620. July 12th.

Electric Cord Grips. M. H. Goldstone and J. Lightfoot. 17,819. July 27th.

Rheostats, Electric Heaters, or the like Devices. H. W. Leonard. 19,019. August 12th.

Electric Heating Apparatus for Baths, Washing-Machines and the like. H. Lofquist. 19,100. August 13th.

1911.

Apparatus for Facilitating the Packing of Magnetic Material. O. Gamper. 4,077. February 17th.

X-Ray Bulbs and Tubes. Barrett & Gaiffe. 6,833. (Convention date, September 7th, 1910.)

Trolley Bases for Electric Traction Systems. E. M. Munro and Railless Electric Traction Co. 7,198. March 22nd. (Divided application on No. 11,157 of 1910, May 5th.)

Electric Lighting Plant for Railway Trains. Julius Pintsch Akt.-Ges. 996. January 13th. (January 17th, 1910.)

Aerial Conducting Structures for Wireless Telegraphy and Telephony. H. Lange. 2,242. January 28th. (February 2nd, 1910.)

Electric Lamp Switches. J. A. M. Traus. 2,520. January 31st. (February 4th, 1910.)

Alternating-Current Arc Lamps. Körting & Mathiesen Akt.-Ges. 6,336. March 14th. (March 29th, 1910.)

Electric Block-Signalling Systems. Siemens Bros. & Co. (Siemens and Halske Akt.-Ges.) 6,627. March 16th.

Arrangements for Regulating the Voltages of Direct-Current Machines Running at Variable Speeds. Allgemeine Elektricitäts Ges. 8,150. March 31st. (April 1st, 1910.)

Side-Walks with Coloured Translucent Advertising-Plates which may be Intermittently or Continuously Lighted by Electric Lamps. L. Bertrand. 19,411. August 18th.

Electrical Manufacturing Problems in Canada.—

The June issue of the *Canadian Electrical News* has the following interesting observations in an editorial entitled "Active *v.* Protective Assistance":—

"One of the most forceful arguments that has been advanced by the manufacturers themselves in favour of a continuance of the present 'Protection' arrangements is to the effect that our products have not yet reached that condition of economy in manufacture, and, in some cases, that high standard of quality, which is necessary for successful competition against the output from the older established factories of the United States and the European Continent. There is probably some truth in this. It would appear, therefore, that the protective system of the past, which at best is a negative, passive kind of assistance for the manufacturer and no help to the consumer, is not, in itself, of sufficient constructive value to place the growing manufacturers of Canada on a sufficiently high plane. The whole matter can well be resolved into a question of quality. Certain lines of electrical products, for example, of our own continent fear competition with the old world, not so much on account of labour conditions, that argument so often advanced, as on account of the wonderful excellence of the finished article. And wherein does this difference lie? Why does it exist? It is plainly not the fault of the individual manufacturing concerns, for these, driven by competition, have spent, where they had it, immense sums of money on experiments, improvements and extensions, and, entirely to their credit, have always succeeded in taking a prominent place in world competition. But this applies to too few in Canada, for too few have had the means to make the necessary researches and experiments from which such progress follows, and the Government has given them only sympathy (protection). The result is that the standard of excellence of Canadian products—the average—has not been raised as quickly as it would have been if such active co-operative Government assistance as is given in many other countries had been extended to the struggling Canadian manufacturer. The alternative is active, helpful, upbuilding Government assistance, such as would enable the manufactured products of Canada to compete alongside of the most highly finished product of the whole world. Then the cry of 'Made in Canada,' which at best is only half right, would be forgotten and Canadians would buy Canadian products because it would be impossible to get anything better by going away from home. There can never be any loyalty slogan half so effective as 'Canada's product the best.'"